FACTORS AFFECTING OPERATION AND MAINTENANCE COST OF HOTELS IN SAUDI ARABIA

BY

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Dedicated to:

My grandfather (Gul Lala), my beloved parents, my brothers and sisters, my sweet daughter Sundus and cute son Muhammad Taqi and finally, to my life partner; my wife, for their love, encouragement and prayers.

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LIST OF ABBREVIATIONS

BSI	**:**	**British Standards Institution**
CAGR	**:**	**Compound Annual Growth Rate**
GCC	**:**	**Gulf Cooperation Council**
GDP	**:**	**Gross Domestic Product**
IRR	**:**	**Internal Rate of Return**
LLC	**:**	**Life Cycle Costing**
O&M	**:**	**Operation and Maintenance**
R&M	**:**	**Renovation and Maintenance**
SAR	**:**	**Saudi Arabian Riyal**
UN	**:**	**United Nations**
VFR	**:**	**Visit Friends and Relatives**
WTO	**:**	**World Trade Organization**

ABSTRACT

Full Name : Bakhter Ihsan

Thesis Title : Factors Affecting Operation and Maintenance Cost of Hotels in Saudi Arabia

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Hotels, as a major part of the tourism industry has a significant impact on local economy of any country. It represents a considerable number of small to medium-sized business. In Saudi Arabia, the total contribution of travel and tourism to Gross Domestic Product (GDP) was SAR 244.6 billion in 2016 (10.2% of GDP) and is expected to grow by 6.4% to SAR 260.3 billion (10.3% of GDP) in 2017. It is anticipated to rise by 4.7% to SAR 412.0 billion by 2027 (11.1% of GDP) (WTTC, 2017). When it comes to the operation and maintenance of constructed facilities, specifically in buildings, they will only remain as valuable asset, when they are properly operated and maintained.

The main objectives of this research are the following; (1) to identify and assess the factors affecting the operation and maintenance cost of hotels facilities in the eastern province of Saudi Arabia; (2) to compare the obtained results for all three groups of hotels including three, four, and five-star. The methodology adopted for this research is based on review of the existing literature and interviewing of local experts. Reviewing the literature and interviewing the local experts have resulted in identifying 46 factors. 23 responses were gathered from the full population of the 47 hotels in the Eastern Province of Saudi Arabia, 14 five-star, 15 four-star and 18 three star hotels. The importance of the identified factors is determined using a statistical package. A reliable overall response rate of 50% was

achieved. To check the agreement among the ranks of three respondents' groups, the Kendall coefficient of Concordance test was applied. Also, to accept or reject the null hypothesis, the Chi-square values were determined.

Built on the results of the survey and experts judgment the most important factors affecting the operating and maintenance cost of five star hotels are "climatic conditions", "availability of the materials" and "annual energy consumption rate". For four star hotels, those factors are "star rating of the hotel", "customer satisfaction" and "occupancy rate". Finally, the top ranked factors for three star hotels are "climatic conditions", "floor area" and "glass and non-glass façade". The shared concern between the respondents of all three groups of hotels is relevant to the energy department, which keeps the facility running and directly affected by the climatic condition. The results were shared to the O&M experts of hotels and their concerns helped a lot to draw effective conclusion and recommendations for this research.

ملخص الرسالة

الاسم الكامل: باختر احسان

عنوان الرسالة: العوامل المؤثرة في اسعار الصيانة والتشغيل في الفنادق المملكة العربية السعودية

التخصص: الهندسة المعمارية

تاريخ الدرجة العلمية: مايو 2017 م

الفنادق، باعتبارها جزءا رئيسيا من صناعة السياحة لها تأثير كبير على الاقتصاد المحلي في أي بلد. وهي تمثل عددا كبيرا من الأعمال التجارية الصغيرة والمتوسطة الحجم. في المملكة العربية السعودية، بلغ إجمالي مساهمة السفر والسياحة في الناتج المحلي الإجمالي 244.6 مليار ريال سعودي في عام 2016 (10.2٪ من الناتج المحلي الإجمالي)، ومن المتوقع أن ينمو بنسبة 6.4٪ إلى 260.3 مليار ريال سعودي (10.3٪ من الناتج المحلي الإجمالي) في عام 2017 ومن المتوقع أن يرتفع بنسبة 4،7٪ ليصل إلى 412،0 مليار ريال بحلول عام 2027 (11،1٪ من الناتج المحلي الإجمالي) (WTTC، 2017). فيما يتعلق بتشغيل وصيانة المرافق وتحديدا المباني، فإنها ستبقى فقط كأصول قيمة، عندما يتم تشغيلها وصيانتها بشكل سليم.

تتمثل الأهداف الرئيسية لهذا البحث فيما يلي: (1) تحديد وتقييم العوامل المؤثرة على تكاليف تشغيل وصيانة مرافق الفنادق في المنطقة الشرقية من المملكة العربية السعودية. (2) مقارنة النتائج التي تم الحصول عليها لجميع المجموعات ثلاثه واربعه وخمسة نجوم من الفنادق. وتستند المنهجية المعتمدة في هذا البحث إلى استعراض المسح الادبي وإجراء مقابلات شخصيه مع الخبراء المحليين. وقد أدت مراجعة الأدبيات وإجراء المقابلات الشخصيه مع الخبراء المحليين إلى تحديد 46 عاملا. تم جمع 23 استمارة استبيان من مجموع 47 فندقا في المنطقة الشرقية من المملكة العربية السعودية، و 14 فندقا من فئة الخمس نجوم، و 15 فندقا من فئة الأربعة نجوم، و 18 فندقا من فئة ثلاث نجوم. وتم تحديد أهمية العوامل المحددة باستخدام حزمة إحصائية. تم تحقيق معدل استجابة عام موثوق به بنسبة 50٪. للتحقق من الاتفاقية بين مجموعة من ثلاثة مجيبين، تم تطبيق الاختبار Kendall coefficient of Concordance، أيضا لقبول أو رفض الفرضية الفارغة، تم تحدد قيمة Chi-square.

بناء على نتائج المسح وتقدير الخبراء. أهم العوامل التي تؤثر على تكاليف التشغيل والصيانة من فنادق الخمس نجوم هي "الظروف المناخية"، "توافر المواد" و "معدل استهلاك الطاقة السنوي". وبالنسبة للفنادق الأربعة نجوم، فإن هذه العوامل هي "تصنيف النجوم للفندق" و "رضا العملاء" و "معدل الإشغال". وأخيرا، فإن العوامل الأعلى تصنيفا للفنادق الثلاث نجوم هي "الظروف المناخية"، و "المساحة الأرضية"، و "الواجهة الزجاجية وغير الزجاجية"، ويتعلق الاهتمام المشترك بين المجيبين من جميع مجموعات الفنادق الثلاث بقسم الطاقة، وتبقي المنشأة قيد التشغيل وتتأثر بشكل مباشر بالظروف المناخية، وقد تم تبادل النتائج مع خبراء الفنادقوساعدت مخاوفهم كثيرا على استخلاص نتائج وتوصيات فعالة لهذا البحث.

درجة الماجستير في العلوم

جامعة الملك فهد للبترول والمعادن

الظهران 31261

المملكة العربية السعودية

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Hospitality

A recently published international economic report by Saudi Commission for Tourism & National Heritage has revealed that Saudi Arabian hotel market is extraordinarily massive with attractive investment occasions. The next five years, it is expected that 34,882 new rooms will be built and they are to be distributed across different major and secondary cities. The report also stated that based on the existing ratios of profitability to the current economy hotels, new developments prove to be a profitable investment, with potential internal rate of return (IRR) ranging among 18 and 21 percent (SCTH, 2014).

The total contribution of travel and tourism in Saudi Arabia to Gross Domestic Product (GDP) was SAR 244.6 billion in 2016 (10.2% of GDP) and is expected to grow by 6.4% to SAR 260.3 billion (10.3% of GDP) in 2017. It is forecasted to rise by 4.7% to SAR 412.0 billion by 2027 (11.1% of GDP). This reflects the industries generated economic activity such as airlines, hotels, travel agents, and all other passenger related transportation services as depicted in Figure 1-1 (WTTC, 2017).

In 2013, Saudi Arabia accounted for the second highest number of the international tourist arrivals amongst the gulf countries which stood at 13.2 million. However, its share in the

GCC region declined from 45.5% in 2011 to 33.4% in 2013 principally due to expansion projects presently going on in the two holy cities, Makkah and Madinah (SCTH, 2014) and (Capital, & Investment, 2014).

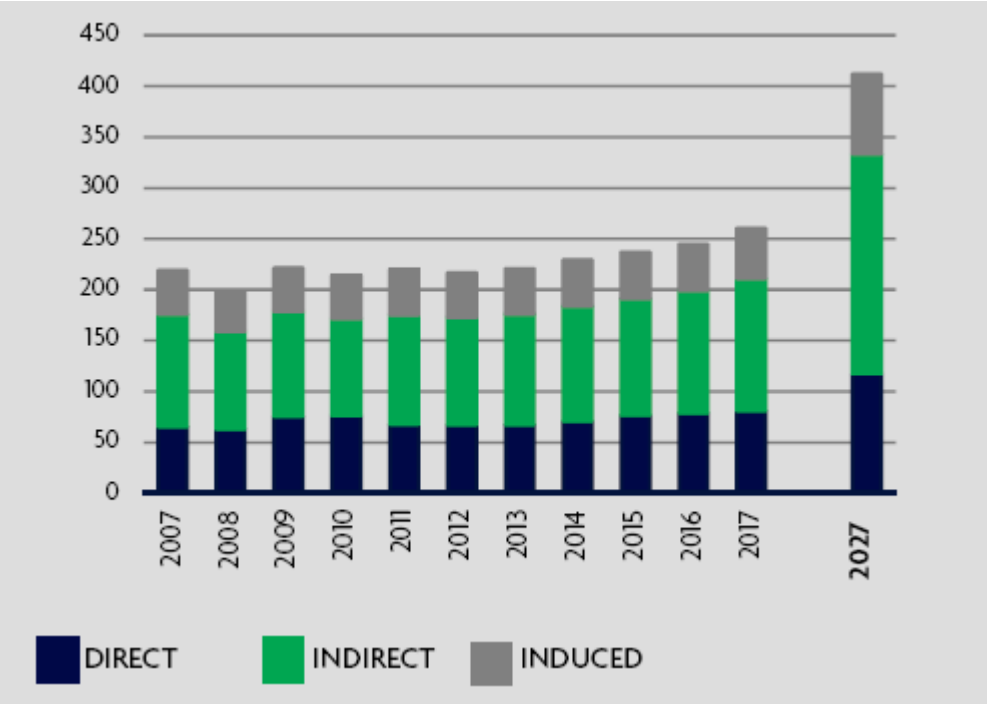

Figure 1-1: Total contribution of travel and tourism to GDP (WTTC, 2017)

1.1.2 Maintenance of Building Facilities

As a hospitality industry, guests' impression as well as perfect O&M of the services systems of building has a significant and nonstop influence on hotel's business. For example, in a restaurant, in the occasion of insufficient air conditioning in a guestroom, uncomfortable sound generated by the fan-coil unit or leakage of water in the main entrance hall due to poor maintenance, which can penalize the reputation of the hotel, victim guests' comfort and do disturb their accomplishments. To avoid the happening of these things, it is essential to understand the maintenance methods and their magnitudes on the performance of engineering system (Chan et al., 2001).

As a valuable asset, a building facility functions properly when it is well operated and maintained. Structural reliability, water-tightness and nice appearance requires maintenance to keep it as it should be. Moreover, the service systems require an effective O&M to make sure that the conditions of indoor environment are facilitated and under control for moving and working, in or out to get the goods and services they want or to adore the features inside the building (Yik, & Lai, 2007).

In any country, the tourism industry has a significant impact on local economy. It represents a considerable number of small to medium-sized business (Önüt, & Soner, 2006). In hotels, one of the challenging, dynamic and complex task is to operate and maintain them to function and operate effectively. Hotel facility has different spaces for different use that has different timetables and utilization such as restaurants, guestrooms, health club, retail store, laundry, swimming pool, function rooms, etc. These functional areas need various engineering systems and they must have kept operating 24-hours all year around (Chan et al., 2001).

(Yik, & Lai, 2007) stated, to ensure the conditions inside a building is kept under appropriate control and the environment is well-facilitated for the people to work and easily move in and out, the services systems require proper operation and maintenance plan. The authors also indicated that the main operation and maintenance cost elements contain of expenditure of energy expenditures, human resources, expenditures for spare parts and consumables required in the repair and routine service of tool, and charges for several utilities. Correspondingly, the cost required for providing the services can be minimized by appropriate O&M work.

1.2 Problem Statement

To ensure a hotel building is function and operate properly, it must be maintained to a satisfactory standard. Hence, the maintenance costs embrace all money consumed on a building to keep it up to an acceptable standard. Generally, the maintenance costs of facility especially hotel buildings are increasing quickly over the facility service life. This quick rising of the maintenance cost in hotel building is influenced by some factors.

In this study, these factors will be identified, assessed, and ranked based on their importance. The identification of such factors will help in estimating the needed maintenance cost, which is essential for budget allocation and for preparing the required budget in advance.

1.3 Objectives of the Study

The main objective of this research study is to conduct a field study of factors affecting the operation and maintenance cost of hotels facilities in the eastern province of Saudi Arabia. The objectives include;

1. To identify and assess the factors affecting the operation and maintenance cost of hotel facilities of the Eastern province in Saudi Arabia
2. To compare the most influencing identified factors in three, four, and five star hotels.

1.4 Significance of the Study

The literature review indicated that limited studies were reported to identify and assess the factors affecting the operations and maintenance cost of hotel facilities in KSA. Saudi Arabia is a very important focal point for international tourism and one of leading oil

producing country. This made Saudi Arabia to be a rapidly growing market for hotel industry. Operation and maintenance cost has significant effect on cost efficiency of hotel industry. This study aims to assess the factors affecting the operation and maintenance cost of hotels. The benefits of this study can be summarized as following:

1. As a recent study on the operation and maintenance cost of hotels in Saudi Arabia, this study can be a useful reference for further studies.
2. Identifying and assessing the factors affecting the operation and maintenance cost of hotels facilities can assist in minimizing the maintenance cost by getting control over those critical factors.
3. Identifying of such factors assists the operation and maintenance managers to estimate the budget more accurately.
4. Identifying of such factors assists maintenance managers in scheduling and forecasting the maintenance budget through the year as per facility needs and requirements.

1.5 Research Methodology

A systematic and multi-phase methodology is applied to achieve the stated objectives for this research:

- Step I: Conducting a comprehensive literature review of existing studies to identify the factors affecting the operation and maintenance cost of hotel facilities.
- Step II: Conducting a field study, which involves interviewing a group of local operation and maintenance managers of hotel facilities to identify other factors based on their local experience in Saudi Arabia.

- Step III: Designing a web based questionnaire survey and piloting it with a group of local experts before activating and distributing it to a population of 47 hotels in the eastern province.
- Step IV: Activating and distributing the questionnaire and start collecting feedbacks.
- Step V: Analyzing the feedback obtained from questionnaire, identifying, and ranking the importance of the identified factors.
- Step VI: Drawing conclusion and recommendations.

1.6 Scope and Limitations

The scope of this study is to identify and assess the most influencing factors on operating and maintenance cost of three, four and five-star hotel facilities in the Eastern Province of Saudi Arabia. Some factors will have limitation to this specific selected area for the research. The major limitations of this research can be summarized as:

1. The assessment of the factors will be carried out in hotels, with having three, four and five-star rating.
2. The assessment of the factors will be carried out in the Saudi Arabia- Eastern Province as a region of the study.

1.7 Organization of the Thesis

This study (Thesis) organized in the following chapters:

Chapter 1: Introduction: The main topic for the research introduced in this chapter. It provides a statement of problem, research objectives, significance of the study, the scope and limitation and the systematic methodology applied to this research.

Chapter 2: Literature Review: This chapter provides an extensive review on the previous studies done generally related to the maintenance of hotel facilities as well as residential and commercial buildings. Also, this chapter provides some figures related to the factors affecting the maintenance cost of building facilities.

Chapter 3: Factors affecting the maintenance cost of buildings: In this chapter, all the factors which affect the maintenance cost of buildings are comprehensively reviewed. The categories and sub categories for the factors along with the description provided in this chapter.

Chapter 4: Research Methodology: This chapter provides the way in which we can gain our objective of the study. It also discusses organization and development of the questionnaire survey which is developed based on review of literature and the interviews conducted to the maintenance or engineering managers of hotels. Sample size determination and the evaluation method for different factors and their ranking is another important part of this chapter.

Chapter 5: Analysis and discussion of the results: This chapter describes the method used for analysis of data gained through questionnaire. Also, will discuss and highlight the

most influencing and critical factors affecting the maintenance cost in hotels from the collected questionnaires.

Chapter 6: Conclusion and recommendation: This chapter provides the main conclusion and recommendations made after assessing the factors which mainly affect the maintenance cost of hotel facilities. Also, this part of the study will suggest area for further research.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

Achieving maintenance free buildings is highly desirable, but barely practical. To make sure that a building is suitable for the usage of its purpose, it should be maintained to a satisfactory standard. The costs of maintenance consist of all money paid out on the building to keep it up to an acceptable standard. The maintenance costs are associated with daily repair, protective and development tasks. These costs include the direct cost of maintenance resources such as labor, materials and plants & tools while the indirect costs include administrative cost and cost management and maintenance overhead costs. El-Haram & Horner indicated that the indirect costs might also contain penalty costs fall in the mandatory level of performance or defeat of income (El-Haram, & Horner, 2002).

The operation and maintenance cost is one of the most significant portions of housing expenditure. Fundamentally, operating and maintenance cost contribute to thirty to fifty percent of overall cost reliant on the kind of housing for instance flat, apartment, condominium and so on (Rydell, 1970).

2.2 Definition of Operation and Maintenance

In simple words, maintenance can be defined as “the effort in connection with different technical and administrative actions to keep a physical asset in, or restore it to a condition where it can perform a required function” (BSI, 1993).

(Waziri, 2016) defined the maintenance by its purpose that carried out to retain value of investment, making the building in a condition in which it continuously fulfils its function presenting a good appearance. Maintenance can therefore be referred to all necessary work done to preserve a building with its finishes and fittings so that it continues to provide the same or almost the same facilities and amenities and serve as it did when it was built.

(Don Sapp, 2015) described the definition of the facility operation and maintenance as; "facilities operation and maintenance encompasses all that broad spectrum of services required to assure the built environment will perform the functions for which a facility was designed and constructed. Operations and maintenance typically includes the day-to-day activities necessary for the building and its systems and equipment to perform their intended function. Operations and maintenance are combined into the common term O&M because a facility cannot operate at peak efficiency without being maintained".

(Zainal Abidin et al., 2009) defines the maintenance of building as "The process of reservation and restoration activity of the structure and components of a building. It covers the whole building which includes toilets, rooms, walls, roofs, drains, doors, windows, floors and also the fix furniture".

To conclude, the definitions above clearly illustrate the significance & importance of operation and maintenance of building facilities and its impact on building life cycle duration.

2.3 Previous Studies on the Maintenance of Buildings

Limited studies are reported in literature regarding the factors affecting the operation and maintenance cost of hotels. Nevertheless, there are few studies available which can be

modified and used for the literature survey and then reviewed by the experts in the facilities' industry in Saudi Arabia.

2.3.1 Studies on the Maintenance of Hotels

Recently, (Pitt et al., 2016) conducted a study in Sanya of China entitled "hotel maintenance management" in which the purposes of the study were to identify the constraints and challenges of hotel maintenance from the viewpoints of key stakeholders and to determine the strategies and processes employed in the maintenance. In their findings, availability of skilled workers, types of systems being serviced and the availability of specialist materials and tools were all found to influence the viability and effectiveness of in-house maintenance as detached from outsourced maintenance. More specifically, the challenges can include a lack of labor training and relatively lower quality of materials and energy efficiency requirements.

In India, (Vij, 2012) employed a methodology which was online surveys and interviews carried out with the use of structured questions on a small but intensive survey of 20 participants from the Indian hotel sector. This study examined the current trends regarding cost structures in the hospitality industry. The respondents of the study were the three, four and five star hotels' financial managers in India. Most of the respondents believe that good management and cost accounting practices are associated with the financial success of hotels. The results of the study suggest that hotels are progressively challenged in finding ways to reduce costs without forfeiting quality.

(Lai, & Yik, 2008) conducted a benchmarking study on the luxury hotels of Hong Kong with the purpose of recognizing the significance and performance of various operation and maintenance cost variables. The key factors that will affect the quantity of operation and

maintenance cost are “service quality” and “scale of work” as presented in Figure 2-1. To assess the effect of mentioned factors, hotels have been divided into two clusters including four-star and five star hotels. Table 2-1 shows the summary of operation and maintenance cost benchmarks (maximum, minimum and mean) of the mentioned hotels. Comparing the mean value of the expenditure for renovation and maintenance, operation and maintenance staff, capital project and water and energy does not draw an apparent conclusion as to which group of hotels should require a higher level of operation and maintenance resources.

Fascinatingly, high expected quality of service and facility hotels which has a star rating of five, driven out to have lower total operation and maintenance expenditure than the hotels with star rating of four, despite the difference was a very small annual amount of money per square meter (Lai, & Yik, 2008).

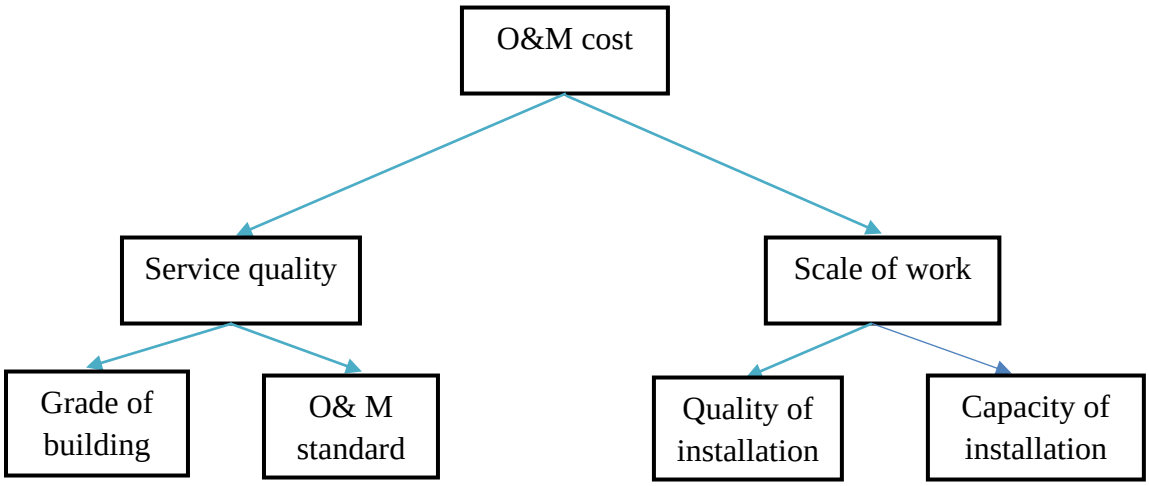

Figure 2-1: Factors affecting operation and maintenance cost (Lai & Yik 2008)

Table 2-1: Benchmarks of annual O&M cost (Lai, & Yik, 2008)

—	Five Star Hotels			Four Star Hotels		
	Mean	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**
R&M cost (HK$/m^2)	208	105	318	182	144	237
Capital projects cost (HK$/m^2)	165	92	299	348	97	527
Energy and water cost (HK$/m^2)	124	88	173	150	131	190
O&M Staff cost (HK$/m^2)	514	438	578	423	304	557
Total O&M cos (HK$/m^2)	980	723	1,195	1,104	771	1,256

It should be mentioned that the difference between four stars and five stars rating is not obvious. A high star rating hotel will have higher class of services and facilities. Secondly, scale difference of the two hotel categories is a clear factor. “The average gross floor area” of the four-star hotel was about twenty percent smaller than that “the average gross floor area” for the five stars’ hotels proposing that the five-star category was more likely to adore a lower unit operation and maintenance cost benefiting from having the larger size. Thirdly, “the average age” of four-star category was 24 being four years older than the five-star category. Younger hotels would need lesser cost for maintaining and operating them. Fourthly, the “occupancy rate” for the four-star hotels was an average of 88 percent while for the five-star category it was five percent lesser, an average of 88 percent. This higher occupancy rate for four-star category indicates that the corresponding operation and maintenance cost would be also higher. As a fifth factor which will be the main cause to the change in expenditure levels is no previously formal benchmarking was executed amongst the hotels (Lai, & Yik, 2008).

(Hassanien, & Losekoot, 2002) outlined some factors related to facility management expertise role in hotel renovation process. The study carried out in Egypt. General Managers' attitude related to the renovation and refurbishment of the hotel was evaluated. In their research, they stated that renovation could play a significant role in the success of hotels due to a bundle of reasons. The classification of these reasons could be as strategic, operational, or functional necessities or purposes to be come across by renovation. The authors listed several different reasons outlined by a group of authors to answer the question "why renovation is important to hotel operations?" which are presented in Table 2-2.

Table 2-2: Reason outlined from some authors why renovation is essential for hotels (Hassanien & Losekoot 2002)

No.	Reason for renovation of hotel
1	To keep up with the competition
2	To maintain or increase market share by satisfying current or potential customers.
3	To improve the operational efficiency of the hotel that will lead to an increase in both productivity and long-term savings in operational expenses.
4	To maintain corporate image and standards.
5	To upgrade the hotel to a higher category (e.g. from four-star to five-star).
6	To comply with the new trends and technology in the market (e.g. the green movement).
7	To cope with the governmental requirements (e.g. The Americans with Disabilities Act in USA).
8	To recover from natural disasters such as hurricanes and earthquakes.

In hotel operations, due to significance of renovation, the respondents were also asked by the survey from three-star, four-star and five-star hotels to point out the key obstacles to renovation. Out of key obstacles to renovation, nearly 70 percent of respondents indicated that the owners are the main barriers to renovation in both full service and limited hotels.

The results of the survey as summarized in Figure 2-2 also outline that in Egypt, amongst the obstacles to renovation process, rank of general managers, shortage of money, shortage of proper in-house experience and shortage of appropriate manpower to renovate in that demand.

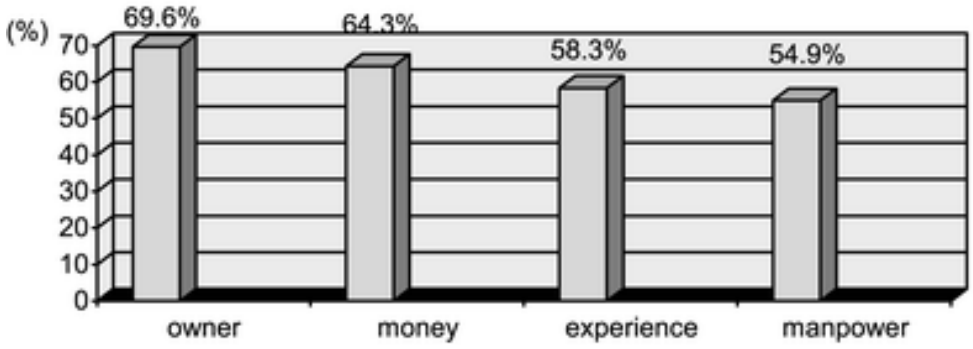

Figure 2-2: Egyptian hotel industry and its renovation barriers (Hassanien & Losekoot 2002)

Respondent were questioned to specify the main purpose to renovate their hotels. Information related to the significance of renovation in hotels is summarized in Table 2-3, which specifies that "improve the current image of the hotel" (51.9 %) was the most significant cause to renovate, trailed by "satisfy the existing customer" (50.9 %). On the other hand, "attract new customers" was the least significant cause to renovate (10.7 %) trailed by "to meet competition" (29.6 %) (Hassanien, & Losekoot, 2002).

Table 2-3: Reason for renovation in Egyptian hotel industry (Hassanien & Losekoot 2002)

No.	Cause for the renovation	Importance in %
1	Improve the current image of the hotel	51.9 %
2	Satisfy the existing customer	50.9 %
3	Extend the useful life of the hotel	50.0 %
4	Increase the hotel's operational efficiency	45.5 %
5	To meet competition	29.6 %
6	Attract new customers	10.7 %

In a study entitled "maintenance practice and energy performance of hotel buildings", (Chan et al., 2003) perceived that the health and safety become essential necessities for a successful business as they depend on good maintenance practice for avoiding the risks in the workplace or facility. A strategy for maintenance sets the path of MM (maintenance management), though the maintenance strategy is a complete schedule of maintenance tasks to be applied in an exact range of time. Since the customer perception of quality is determined by a number of factors relating to food, services, indoor environment and facilities, both; health and safety comprise a high level of decision-making. As for the consumption of energy, the obtained results revealed that management is keen to make each effort to develop an energy-saving maintenance strategy. Intrinsically, a complete maintenance strategy would be developed and executed for keeping the engineering systems reliable, safe, and energy efficient, satisfying customer expectations and needs. The findings of the authors are summarized in Table 2-4, which shows the factors affecting energy performance of hotel buildings.

Table 2-4: Factor influencing maintenance practice and energy performance of hotel buildings (Chan et al., 2003)

Consideration Factors	Average Score	Consideration Factors	Average Score
Health and Safety	4.12	Reliability of system	3.77
Energy consumption	4.12	Criticality of system	3.65
Guest Expectation	4.12	System life cycle	3.65
Degree of influence in business activities	3.96	Annual Budget	3.58
Environmental Impact	3.85	Feedback from other departmental heads	3.42
Hotel Policy	3.85	Manufacturer recommendations	3.38
Maintenance Resources (labour, tools and materials)	3.81	Equipment history records (failure mode, frequency and cause	3.31
Legal requirement	3.77		

Before implementation of outsource, in house contractors, or combination of both numerous factors are considered in maintenance practice. No general role can be found for an adorable ratio of in-house to outsourced labor power on which management decision is established ease of use of capitals and a number of other factors are well thought-out.

In the observation of (Chan et al., 2003), chief engineers ranked the inadequate skills of in house technicians in specialized disciplines as a most significant factor is which motivating the management to hire some outsourcing labor for some retrofitting and maintenance works. “Time constraints” was ranked as a second most important factor since the highest income of the hotels are from the lease of guest rooms and the provision of beverage and food services, including banquet halls and restaurants, thus lengthier downtime of functional areas and critical equipment will lead to a severe business loss. Accordingly, the

management must cautiously match the needed working time with the in-house employees and by the outsourcing contractors. A summary as perceived by the authors shown in Table 2-5.

Table 2-5: Influential factors for considering outsourced and in-house maintenance (Chan et al., 2003)

Consideration Factors	Average Score	Consideration Factors	Average Score
Skills of in house technicians	4.23	Degree of system complexity	3.92
Time constraint	4.19	Financial constraint	3.88
Statutory requirements	4.15	Technical support from manufacturers	3.85
Availability of in house labour force	3.96	Use of proprietary units and parts	3.73
Use specialised tools and requirements	3.96	Historical information	3.35

2.3.2 Studies on the Maintenance of Buildings

In this part of the study, the factors affecting the maintenance cost of residential buildings such as housing and some commercial buildings as hospitals and universities are reviewed. For hotels as a part of commercial buildings, it can be useful and beneficial.

In the present time and as result of the continuous increase in the costs of housing maintenance, many work related to the maintenance costs of housing management has been discussed and published in the literature. It has been found that with the intention of decrease the maintenance costs, some policies should be adopted by maintenance managers to minimize the amount of maintenance tasks. As stated by (El-Haram & Horner 2002), numerous aspects are available that influence the maintenance cost of housing. Commonly, the factors, which affect the cost of housing maintenance, can be allocated under five main categories including; “building characteristics, tenant, maintenance factors, political and others factor”. Each of the main factor is subdivided into numerous variables that influence

the housing maintenance cost as presented in Figure 2-3. The research concluded that five of the most important factors were “expectation of tenants”, “building materials”, “building services”, “building age” and “failure to execute maintenance at the right time”. Simultaneously, it was found that two of the most influential impacts were “outstanding maintenance charges” and “over budget” (A. Ali et al., 2010).

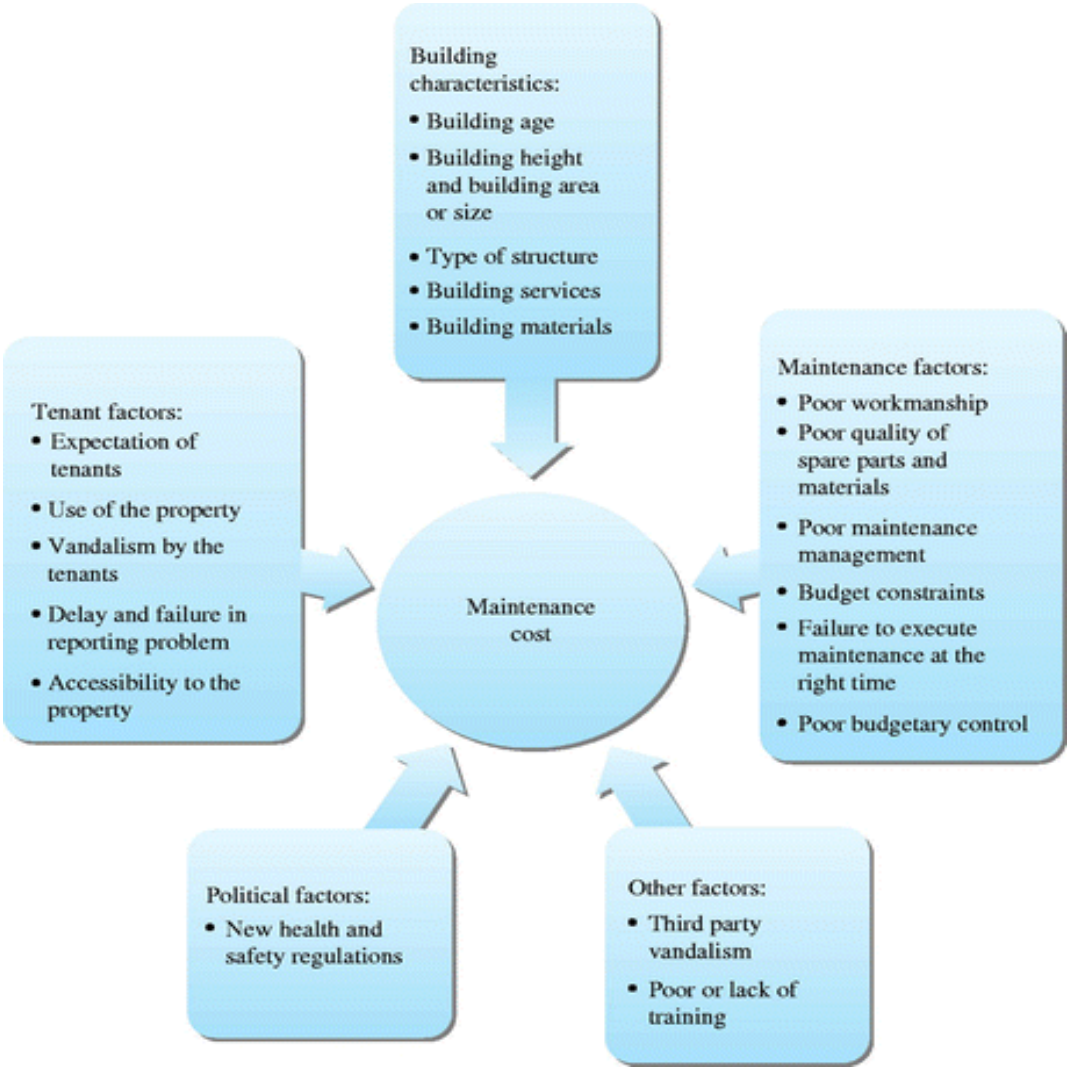

Figure 2-3: Variables of factors affecting cost of housing maintenance (Ali et al. 2010)

(A. Ali et al., 2010) and (El-Haram & Horner 2002) very similarly summarized different factors under five main categories that affect the maintenance cost in buildings as depicted in Table 2-6.

Table 2-6: Factors influencing the maintenance cost in building facilities (Ali et al. 2010) and (El-Haram & Horner 2002)

No.	FACTORS
Tenant Factors	
1	High expectation of tenants
2	Improper use of the property
3	Vandalism by the tenants
4	Delay in reporting failures
5	Complete failure to report problem
6	Inability to gain access to the property
Maintenance Factors	
A. Technical Factors	
7	Selection of sub-optimal maintenance strategy
8	Budget constraints
9	Poor workmanship
10	Poor quality of spare parts and materials
B. Administration Factors	
11	Poor maintenance management
12	Poor failure reporting procedures
13	Failure to execute maintenance at the right time
14	Failure to apply opportunity maintenance
15	Interdepartmental boundaries
16	Poor budget control (Spending large sums of money towards the end of the year to avoid losing it)
17	Accelerated maintenance work due to poor budgetary control
Political Factors	
18	Right to buy policy
19	New health and safety regulations
20	Poor management decision system
Other Factors	
21	Third party vandalism
22	Tenant complaints through different channels
23	Poor or lack of training
24	Energy cost in the case of income support tenants

(Hassanain et al., 2013) carried out almost a similar study entitled “factors affecting maintenance cost of hospital facilities in Saudi Arabia”. The only difference is that the targeted population are hospitals. The authors have identified 33 factors which were categorized under seven groups. These factors are, statutory requirements, design phase, construction phase, management of the maintenance department, budgetary estimates for maintenance activities, operations conducted by the maintenance group and community perception about the maintenance industry.

The most important three factors from the perspectives of the facilities managers of public hospitals were all encompassed within the “construction category”, which deals with the imp acts of construction defects on the cost of maintenance. These factors are transfer of problems from the construction phase to the maintenance phase for resolution, lack of coordination between the construction and maintenance group and lack of quality control measures during the installation of systems. In addition, the most important two factors in private hospitals were encompassed in the statutory requirements category, which deals with the regulations of contract award and administration to maintenance contractors. These two factors are “duration of the maintenance contract” and the method of classifying maintenance contractors.

(Chang et al., 2008) investigated a group of 60 national universities in Taiwan. Using focus groups, expert interviews, questionnaires, and AHP (Analytic Hierarchy Process), the study analyzed 14 evaluation criteria related to a building's attributes and components which influence the development of a building maintenance priority benchmark. Findings of the research is the formulation of a BPM “Maintenance Priority Benchmark” for school buildings in Taiwan National Universities which can deliver government building

managers a valuable reference for maintenance decision making. The proposed group of BPM which contains 14 priority benchmark criteria is shown in Table 2-7.

Table 2-7: Priority benchmark criteria (Chang et al. 2008)

No.	Criteria
1.	Use-necessity
2.	Maintenance urgency
3.	Impact on individuals
4.	Impact on public
5.	Current age relative to age/design limit
6.	Exterior condition
7.	Deterioration of components
8.	Functional impairment of main structure
9.	Functional impairment of walls and finish
10.	Functional impairment of electrical, air-conditioning, communication, and monitoring/control
11.	Functional impairment of plumbing, sanitation facilities, and fire protection
12.	Value improvement rate
13.	Maintenance management efficiency
14.	Use-efficiency

(Al-Khatam, 2003) conducted a review of literature on the factors affecting the cost of maintenance in buildings. The review recognized 34 factors, classified into seven major groups, namely “engineering services”, “labor”, “building materials”, “environment”, “management and administration”, “budget and finance” and “building user behavior.” Based on the review of literature done for the research, it was determined that the major causes for high cost of maintenance in buildings are: absence of local material standards and specifications, owners’ concern about the initial cost, poor supervision and management of maintenance projects, poor scheduling, absence of standardized maintenance contracts and faulty design and construction. Nevertheless, this conclusion was not supported by practical valuation of these factors or case studies.

(Krstić & Marenjak 2012) conducted a study entitled “analysis of buildings operation and maintenance costs”. The main objective of the research was to collect the data about operation and maintenance cost of the university buildings and the variables, which affect such cost of universities in Croatia. The methodology for collecting data was based on questioner which consists of four main groups, namely:

1. General building characteristics
2. Facility maintenance plan
3. Operational characteristics
4. Operation and maintenance costs

The operation and maintenance costs category then, classified into five groups:

I. Statutory periodic inspections
II. Cost of replacing degraded materials and elements
III. Costs or periodic work and repairs
IV. Cost of reactive maintenance
V. Operational cost

Throughout the research, it was recognized that required data can be collected using the methodology applied to this purpose. The research lead into the creation of a database with independent variables, building characteristics and operational characteristics, and dependent variables, operations and maintenance costs which are statistically important for forecasting operation and maintenance costs using the stepwise procedure for the forecast models of the University of Osijek facilities.

2.4 Maintenance Management Approaches

A group of authors similarly defined the major maintenance management approaches presented by (Richard et al., 2000) and (BSI. 1993) are:

1. Failure-driven maintenance (FDM);
2. Time-based maintenance (TBM);
3. Condition-based maintenance (CBM).

As depicted in Figure 2-4, maintenance management approaches are divided in two main categories namely planned and unplanned and then, failure-driven maintenance is a sub category of unplanned maintenance while planned maintenance containing time-based and condition based maintenance.

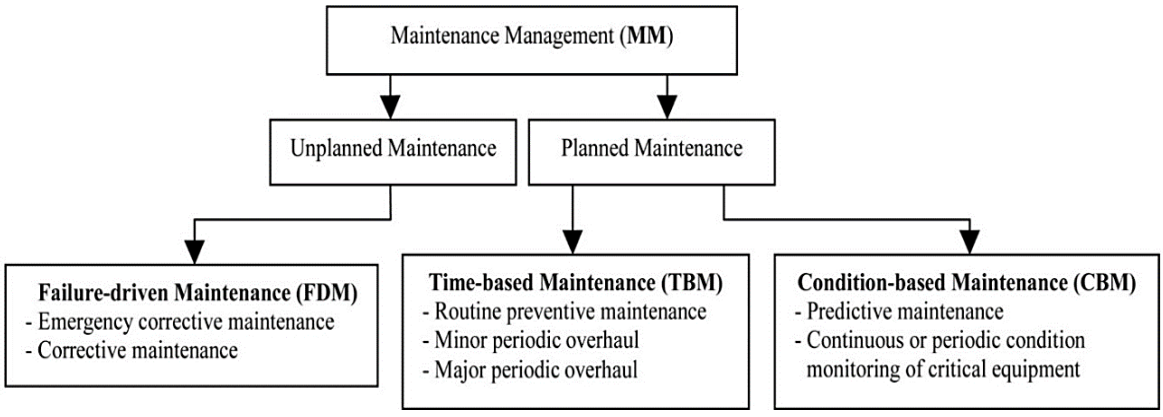

Figure 2-4: The three common approaches of maintenance management (Richard et al. 2000)

(Chan et al., 2003) categorized the maintenance into four main groups, which are routine, corrective, preventive and emergency. Firstly, a maintenance with daily practice and repetitive nature is called routine maintenance like lubricating, monitoring, taking meter readings, startup and shutdown. Secondly, those unscheduled or scheduled activities which bring back the equipment or facility to as-built functions is called routine maintenance.

Thirdly, those planned activities of overhaul, replacement, adjustment and inspection to avoid system failure and prolong its useful life is called preventive maintenance. Final and fourth type of maintenance is emergency type which refers to instantaneous actions to prevent promotion in equipment damage and adverse penalties like loss of business.

As per discussed four type of maintenance activities by (Chan et al., 2003), the comparative portions studied in the hotels are as in Figure 2-5. The results of the research shown that a huge amount as 30% of the maintenance capitals consumed on routine maintenance. On the other hand, the maintenance staff frequently took a behavior of supervising routine maintenance as an unimportant thing. Because of poor awareness, they do not know that preventive maintenance and routine maintenance, if accurately implemented, would efficiently decrease system failure. If there is no a clear maintenance policy, indeed capitals used upon routine maintenance may be misused.

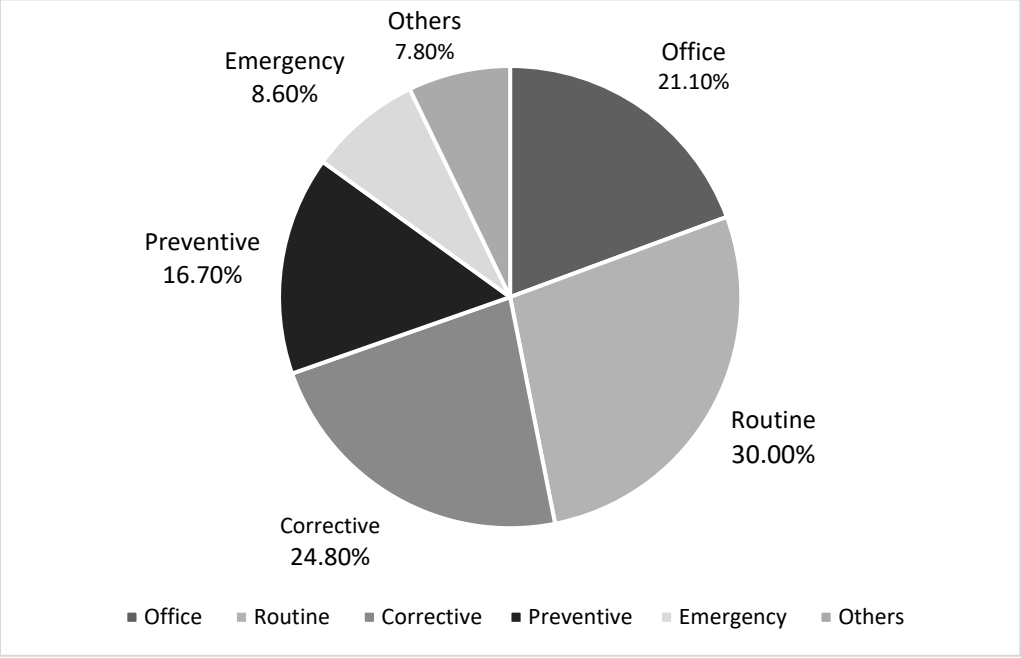

Figure 2-5: Maintenance activities with their percentage breakdown in Hong Kong hotels (Chan et al. 2003)

2.5 Maintenance Cost as a Part of Life Cycle Cost

Operation and maintenance expenses cannot be separated from the building's Life Cycle Cost (LCC). Due to (ISO 15686-5:08, 2008), the whole life cycle costs involve non-construction costs, life cycle cost (O&M expenses, construction, plus any remaining charges) and incomes. Elements of life cycle cost graphically presented in shown in Figure 2-6. Those life cycle costs reflected as life cycle costs and other costs (incomes and non-construction costs), along with life-cycle costs (O&M costs, construction, and remaining charges).

Maintenance costs include the cost of labor and material, besides all additional related expenses that are provoked to possess the building or its portions in the public in which it can accomplish its necessary purposes (Krstić & Marenjak 2012).

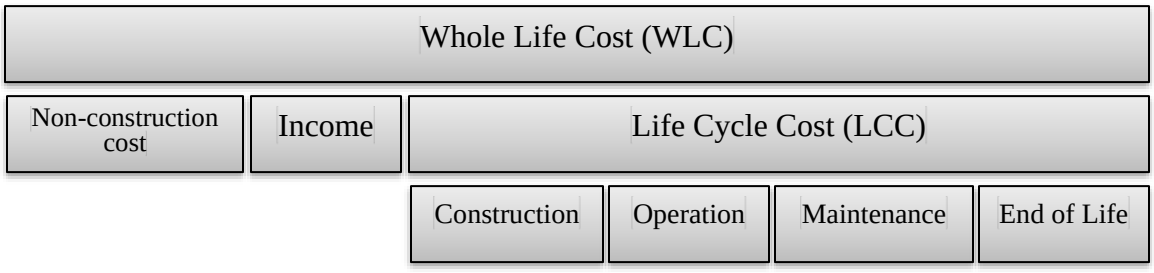

Figure 2-6: Life cycle cost structure along with the Whole life cycle cost (ISO 15686-5:08 2008)

2.6 Tourism, Hospitality and Hotels

2.6.1 Hospitality Overview in GCC Countries

In GCC countries, hospitality sector has achieved significance. Historically, GCC countries have been heavily oil dependent economies. Although, in the past decade, the GCC region has observed numerous economic changes as governments concentrated on non-oil sectors. Tourism is a principal driver for the hospitality sector. As of 2011, accommodation (33.0% of total outlay) made the biggest share of tourist expenditure.

At the end of 2013, the region's total accommodation which stood at 458,045 rooms, Saudi Arabia (63.6%) accounted for the leading share. Between 2006 and 2013, the Kingdom added the maximum number of hotel rooms, which stands at 95,627, registering a Compound Annual Growth Rate (CAGR) of 9.5% (Genenral Strategy, 2003).

2.6.2 Tourism in Saudi Arabia

After the capital city Riyadh, and an important market of business tourism, Jeddah the core and important for the industrial sector is the Eastern Province is in Saudi Arabia. Particularly, the oil industry as it seized almost 86 percent of the basic industries sector. Dammam and Al-Khobar benefit from improved domestic tourism geared towards servicing the oil sector. In Eastern Province, the occupancy rates have historically been lower compared to Riyadh and Jeddah. Furthermore, global crisis by 2010 led to occupancy levels going below 50%. Conversely, in 2011, the market recovered onwards and showing signs of increment. The five and four star hotels conquered the market in Eastern Province, with an available supply of 67.4% in 2012 (Aljazira Capital, 2015).

It will be very important to designate the present dimensions and characteristics of tourism in the Saudi Arabia. It will help create a more significant context for the analysis of the overall market. Generally, tourism in Saudi Arabia dis divided into two main categories which are domestic and international tourism. As per their importance and effect, both of them will be described (Genenral Strategy, 2003).

2.6.2.1 Domestic Tourism

In 2000, demand for domestic tourism was approximated to be about 14.5 million tours with total expenses of 22.4 SAR billion. Mainly, domestic tourism in Kingdom consist of holiday/leisure tourism (along with visiting relatives and friends), religious travel (Umrah and Hajj), conference/business tourism (along with official travels) and medical tourism.

In 2000, an estimation of 6.4 million trips has tended around the red sea, particularly in Jeddah and the mountains around Taif and Asir. Domestic tourism is a highly seasonal and largely family based, and it reach to its highest peak during school holidays (July and August), In both Eid vocations as well as in weekend to a certain degree.

2.6.2.2 International Tourism

Presently, the system of issuing visas for visitors to the Kingdom is not supportive to scaling international tourism to Saudi Arabia. Over the Saudi Arabian Airlines' program "Visit Saudi Arabia", an intensely small number of tourist visas are issued. Therefor, "visit" visas are issued for several ambitions. At the country border, the entry/departure card which is must to be filled by non GCC citizens does not require stating the "purpose of visit" either.

Even though, an estimation of 3.6 million worth SAR 12.8 million were accounted by the related research and survey group in 2000. Each year, almost 3.6 million visitors from different parts of the world came to Saudi to perform Umrah and Hajj. It is essential to know that reported by (WTO/UN) tourism statistical practices and definition, Hajj pilgrims are considered as tourists (Genenral Strategy, 2003).

To conclude, International and domestic tourism to the Kingdom can be divided into four main groups, namely:

1. religious travel (Hajj and Umrah),
2. business and conference,
3. leisure/holiday tourism (essentially by nationals from other GCC states), and
4. Visits to friends and relatives (VFR).

As cities for Muslims, Makkah and Madinah are the cities in which first category, religious tourism is focused. The second and third categories, business and conference as well as leisure/holidays truism, are mainly performed in Riyadh, Jeddah, Dammam and Al-Khobar. As mentioned in the limitation of the study, the research will focus for hotels in the Eastern Province of the Kingdom. More specifically, the cities of Dammam and Al-Khobar in which non-religious international trips are occurred. They serve the business community by providing hotel rooms around 2000 in each of Al-Khobar and Dammam (Genenral Strategy, 2003).

Recent research by the "Research and Market department of Reuters, 2014" highlights that: "Saudi Arabia, with its increasing domestic and international tourist volumes driving the

growing demand for accommodation, has also seen an increase in investment in the hotel market" (Reuters, 2014).

2.6.3 Star Rating of the Hotels

According to the "classification manual for hotels by; Abu Dhabi Tourism Authority ADTA, 2007" the different criteria that must be met for every classification level are designated in Table 2-8.

Table 2-8: Star rating along with the criteria (Abu Dhabi Tourism Authority 2007)

Star Rating	Criteria
One Star	• Basically, must provide the important comfort. • Required to meet the basic mandatory standards and the relevant criteria rating for this level of hotel. • Clean and well maintained offering a limited range of facilities and services. • The restaurant/eating area is open for breakfast and dinner.
Two Star	• High standard of cleanliness, comfortable and simple accommodation. • Straightforward range of services with a more personal touch. • Required to meet the basic mandatory standards and the relevant criteria rating for this level of hotel. • Higher standard of restaurant/eating area open for breakfast and dinner.
Three Star	• More spacious public areas and bedrooms. • A high standard of cleanliness, equipped and comfortable accommodation. • Higher quality and standards of services and facilities, more formal style of service. • Required to meet the basic mandatory standards and the relevant criteria rating for this level of hotel. • Higher standard of restaurant/eating area open for breakfast and dinner. • Room service of continental breakfast for a limited number of hours per day and have higher quality of food.
Four Star	• More spacious public areas and bedrooms • High standard of cleanliness, superior comfort & quality accommodation • Attached facilities with shower and bathtub, higher quality and standards of services and facilities. • Required to meet the basic mandatory standards and the relevant criteria rating for this level of hotel. • More formal style of service, skilled staff anticipating and responding to guests needs. • Higher standard of restaurant/ eating area open for breakfast and dinner. • Room service of all meals, 24-hour availability of drinks & snacks and a higher quality of food.
Five Star	• Larger hotels with even more spacious public areas and bedrooms. • Luxurious and special surroundings offering the highest quality of accommodation and standards of cleanliness. • Required to meet the basic mandatory standards and the relevant criteria rating for this level of hotel. • Guest accommodation is luxurious and spacious, more formal style of service. • professional, attentive and highly trained staff. • Higher standard of restaurant/eating area open for breakfast, lunch and dinner • Room service of all meals and 24-hour availability of drinks & snacks with a higher quality of food & outlets.

Due to some major websites which manage hotels related business. As professional websites in tourism and accommodation, they developed some criteria for rating of hotels. To put ratings in context, each of the major travel sites has simplified definitions for it as in Table 2-9.

Table 2-9: Star ratings in context along with their travel sites. (smarttravelers.com 2016)

Star rating	Travelocity	Expedia	Orbits
One-star	Meets budget basic needs	Economy, no-frills accommodations	Simple accommodations
Two-star	Meets basic needs	Value, clean, basic	Value, comfortable, affordable
Three-star	High service, additional amenities	Quality, style, comfort, personalized service	Mid-scale, convenience plus comfort
Four-star	Superior property, variety of amenities	Superior, upscale, high quality	Deluxe/upscale, comfort plus quality
Five-star	Luxury setting, flawless guest services	Finest hotels, luxury, superlative service, highest comfort standards	Luxury, first-class services, well equipped and state of the art facilities

CHAPTER 3

Factors Affecting the Maintenance Cost of Buildings

Various researchers investigated a series of factors affecting the maintenance cost of different types of building facilities. These factors can be applied for hotel buildings as a part of commercial buildings. Gained from literature, following are the factors affecting the maintenance cost of building facilities:

3.1 Technical Factors

Technical faults are significant critical sources as well as costly throughout the O&M phase of a building. These factors should be considered during planning, design, construction or even maintenance and that is why they do not belong to a specific phase (Saghatforoush et al., 2012). They include design problems, faulty maintenance, construction defects and building characteristics.

3.1.1 Design Problems

Design problems have a significant influence on a building during maintenance works and as a result affect the cost of maintenance. It refers to defects that occur during the design and construction stage of a building. Commonly, design is not only concerned with building or housing morphology, but also with specification and methods of construction (Olubodun, & Mole, 1999). These problems constitute faulty and complex designs. According to (Wordsworth, 2000), faulty design include failure to follow well established design criteria while complex designs are those that are difficult to execute or comprehend by either contractors or maintenance managers when carrying out maintenance works. Also, faulty design which consists of all faults that were caused during the early stage of

design and mainly in the structural design such as ignoring the spacing for contraction and expansion movement by the designer which causes cracking of the structure, and finally, will definitely result in breakages in joint failure or pipes (Al-Shiha, 1993).

3.1.2 Building Characteristics

Building characteristics always influence the maintenance. This contains building materials, building age, and building structure. Building materials used in buildings dictate the rate of wear and tear, therefore materials that have a short lifespan is likely to increase the cost of maintaining buildings due to frequent replacements. Building age refers to life of a building. Therefore, old buildings are likely to require immediate maintenance and might require massive maintenance of the various building components; unlike new structures where partial maintenance may be needed. Finally, building height also affects maintenance as tall structures are more costly to maintain since extra cost is needed in hiring plants and equipment such as scaffolding (El-Haram, & Horner, 2002).

3.1.3.1 Building Materials Used

The lowest initial cost of commercial building and replacing building components does not necessarily mean the most economical. In comparison to the more expensive alternatives, sub-standard and cheaper materials require frequent maintenance and possibly will have a short life span.

In order to meet the expected performance requirements, selection of the materials is very influencing. Using low quality materials will definitely cause failure to the materials, which will require correction, replacement or more maintenance work in future (Al-Khatam, 2003).

3.1.3.2 Usage of New Materials or Ignorance of Materials' Properties

Nowadays, building designers are challenged with new materials having lack of understanding about their characteristics and behavior. Similarly, sometimes they are untested and not having satisfactory guarantees. A never-ending maintenance is the result of using such materials. Moreover, poor understanding about the behavior and nature of materials finally causes failure of buildings (Mahmoud, 1994).

3.1.3.3 Building Height and Structure

The height of a building negatively influence maintenance cost as additional apparatus are needed for maintenance. An example would be scaffolding for maintenance tasks such as window repairs and exterior beautification. The structure type of a building can also significantly influence the maintenance cost (A. Ali et al., 2010). The structure requires a great amount of financial resources for maintenance, inspection, repair, replacement and rehabilitation. In order to ensure the occupants' safety, the structural stability of a building must be maintained and inspected frequently (Neves et al., 2004).

3.1.3.4 Building Age

Age is one of the important elements to be considered in dedicating the maintenance resources. In general, the older is the building the more attention is needed to carry out special maintenance work. Life-cycle management and facility management which are connected together show that a huge amount of money from building owners are required to carry out maintenance work when a building reaches to its economic life span (Lateef, 2009).

(Olubodun, & Mole, 1999) conducted an evaluation of defect influencing factors on public housing in UK. They found that the age was on the top of the five most influencing design problem factors. Because of corrosion problems, remedial cost and higher maintenance cost are required for aged drainage and plumbing systems in buildings (A. Ali et al., 2010). Building age is a dominant indication for required level of maintenance service (Álvarez Gil et al., 2001).

3.1.3 Poor Quality Control

Quality control is defined "a process used to inspect, control, test and record procurement, fabrication and installation in accordance with contract document". Quality control program should be set out during the construction and maintenance stages. In comparison of a facility where no quality control program is considered to a facility with an effective quality control program has fewer defects and thus needs less maintenance. Also, to assure that the components are required as per the contract documents, during the period of the maintenance stage, the presence of quality control is vital (Mahmoud, 1994).

3.1.4 Low Concern to Future Maintenance

As per the importance of the maintainability and one of the significant aspects of the design, it must be part of the total design process. Maintainability necessities are well-defined and explained into design criteria during the planning stage. Also, to begin the anticipated physical and functional characteristics of the system, these criteria are applied to the design. To validate quantitative goals and then translate them into improvement of design of the system, the design characteristics are measured. If maintenance analysis is ignored during

the design stage of building, serious problems can be caused related to safety, performance and function of the system (Patton, 1988).

3.1.5 Failure in Identifying the True Cause of Defect

To consider all the probable causes, the worker should examine carefully all symptoms by an elimination process to identify the true causes and their sources, and then decide on proper corrective action. Because this will not only do nothing to remedy the original defect but may substantially worsen the condition of the building (Wordsworth, 2000).

3.2 Environmental Factors

They are factors that enable maintenance activities to be carried out with ease by creating a conducive working environment and include external factors. These are some of the examples of environmental factors: new maintenance techniques; unqualified and unavailable maintenance contractors; inadequate standards and specification and harsh climatic conditions.

3.2.1 Inadequate Standard and Specification

Specifications and standards refer to documents which indicating materials, technical requirements and show that if performance requirement meet with specifications and standards. Preservation, support, performance, packing and making requirements are included in this document (Patton, 1988). Furthermore, these specifications and standards are important because of below reasons:

- Serve as the guidelines for contractors;
- Describe workmanship and;

- Indicate material requirements.

Existing of uniform specifications and standards make easier the construction process and maintenance performance (Seeley, 1987).

3.2.2 Harsh Climatic Conditions

In building materials, weather condition is often responsible for chemical action. The main climate related cause for rapid deterioration of some materials is atmospheric pollution associated with rain. Inconsistent weather conditions would rapidly affect the quality of materials leading to rapid wear and tear within a short period. For example, paint is likely to peels off due to temperature variation; hence expenditure is incurred before the stipulated time as set in the maintenance policy (Patton, 1988).

3.3 Managerial Factors

The aspect of management is crucial in maintenance works. In most commercial buildings, managerial role is delegated to maintenance manager and contractor. It involves organizing, controlling, planning and staffing. These components are significant when carrying out maintenance works and as a result affect the maintenance cost of the building. The managerial factors that have a direct bearing on the building maintenance cost constitute:

3.3.1 Equipment

The high maintenance price is allocated by poor quality of spare parts and materials used in the building components, elements, services or facilities (Al-Hammad et al., 1996).

Unavailability of the compulsory materials, tools or spare parts to execute maintenance tasks negatively influences the maintenance cost (A. Ali et al., 2010).

3.3.2 Labor

The maintenance is a labor-intensive activity and therefore the greatest economies are likely to flow from measures that improve labor productivity. It is generally recognized that maintenance requires greater skill than new construction work. The choice between employing consultants or tradespeople directly, and engaging an independent contractor for that purpose, should be decided according to which offers the greater advantage in terms of cost, quality and convenience. The choice of labor may constitute in-house staff that is more economic than out-sourced staff. Maintenance works despite requiring adequate and sufficient labor is faced by various shortcomings that impact negatively on the maintenance expenditure (Wordsworth, 2000). Labor related factors that directly influence the cost of maintenance include:

3.3.2.1 Unavailability of Skilled Laborers

In maintenance work, to execute job and utilize equipment professionally, availability of skilled labor is very significant. To do good quality the work in less time, employing labor with the required skills is mandatory, and it is cost effective. Hence, only having the right tools never means that the job will be performed accurately (Al-Khudair, 1988).

3.3.2.2 Faulty Workmanship in the Initial Construction

In the building process itself, some building defects have their own source. During construction, according to some inaccuracies, the fixing and bearings cannot bear the differential movements which results in structural defects. As mentioned by (Mills, 1980).

(Al-Khatam, 2003) hiring labor with required skills will not only improve the quality of the work, but it will also be effective in reducing work time-span and cost.

3.3.2.3 Uneducated Labors

In many cases education is very similar to intelligence. For labors, the education ranges from advanced degrees up to none. Training, which of course is a form of education, also ranges from zero (many labors have been put on the job with no preparation whatsoever) to very extensive courses involving on-the-job training, classroom training and orientation. Trained and educated labors can easily build a relationship to others and perceive the transmitted information or instruction (Shear, 1983).

3.4 Factors Related to the operations Conducted by the Maintenance Group

3.4.1 Unfamiliarity with the Use of Technology

To execute some maintenance work, a certain type of technology is required. Maintenance staff who are inadequately trained in the use of the required technology will end up with faulty maintenance and rework, which will undoubtedly increase the maintenance cost (Hassanain et al., 2013).

3.4.2 Poor Performance of the Maintenance Group

For any successful project, one of the necessary part is team effectiveness. Since maintenance is also performed as a teamwork, the factors that increase the effectiveness of the work of the team should be considered. An ineffective team will not only affect the productivity of the workers but it will increase the cost of maintenance as well (Azmy, 2012).

3.4.3 Poor Communication Between the Maintenance Group and the Users

Poor communication between the maintenance group and the users, consequences in concentrating on maintenance that is not essentially the main cause of the defect demanding reparation. This miscommunication will result in extra work, which will eventually affect the maintenance cost (Choon Hua et al., 2005).

3.5 Financial Factors

As a cost and maintenance related topic, financial factors have their own importance which can never be ignored. Following are the financial factors outlined from previous studies done on factors affecting maintenance cost of building facilities.

3.5.1 Inadequate Finance for Maintenance Work

It is significant for building owners to allocate enough money for maintenance work while they prepare their annual budget. If it is not the case, the maintenance is observed as a "necessary evil" and an inescapable cost load for projects. Therefore, maintenance activities are not executed on the basis of actual need. This will create an over-budget problem in the O&M stage due to deferral of some maintenance activities (Moua, & Russell, 2001). According to (El-Haram, & Horner, 2002),not performing maintenance at the exact time is often due to inadequate budget allocation. For executing of such maintenance and repair works, additional expenditures and costs are required which are not allocated in the budget (A. Ali et al., 2010).

3.5.2 Poor Financial Control when Executing Maintenance Work

In order to achieve better on-site financial control and minimize maintenance cost, maintenance management should be aware of these factors; availability of material, materials waste, labor productivity, effective and useful maintenance approaches, good maintenance planning, and using effective tools and equipment should be financially controlled on site (Al-Juwairah, 1997).

3.5.3 Failure to Forecast the Accurate Maintenance Expenditures

Meanwhile, maintenance will be executed in the future, the cost of maintenance is an estimate based on experience and the type of work performed. However, estimates could be not accurate due to unknown and unexpected factors. Therefore, the actual cost of maintenance will be influenced due to the ambiguity (Christian, & Pandeya, 1997).

3.5.4 Inflation of Maintenance Cost

The general increase in prices due to numerous factors that is out of control of the facilities manager is called inflation. Maintenance will have an effect on the cost of materials and labor. It is noted that in recent years, the rate of inflation has increased. That would lead to directly affect the expenditure of maintenance (Hassanain et al., 2013).

3.6 Social Factors

These factors involve Reporting delay, user awareness; and accessibility to the property. To reduce the maintenance cost, early reporting and early response to the building failure is necessary (Saghatforoush et al., 2012). One of the main factors that affect maintenance

cost is difficulty in gaining access to the property (El-Haram, & Horner, 2002). Some of these factors include:

3.6.1 End Users' Behavior

Building users habitually give less attention to keep their buildings in decent working order and are surprised when they fail to give the service they expected. This misuse of building services will result in damage that needs to be repaired which of course will be overpriced. Likewise, the unusual occupier activities can make the deterioration to occur rapidly. Improper use of buildings will definitely increase the rate of wear and tear and repairing cost (Al-Khatam, 2003).

3.6.2 Occupancy Rate

The occupancy rate is a performance indicator in the hotel industry. This magnitude has the advantage of being widely used among hotels. Furthermore, it is regarded as an index of the hotel's level of activity (Damonte et al., 1997) and (Johns et al., 1997).

3.6.3 Cultural Practices

The way in which people deal with others and perform their duties can differ from one culture to another. The maintenance management team faced many problems to operate and maintain the building due to the impact of culture practices. An example of how work becomes more difficult due to some cultural practices is inappropriate use of toilet bowls due to customaries influenced by culture. Negative behaviors which are influenced by cultural practices can cause high maintenance cost. Some tenants, who carelessly use

facilities in commercial buildings due to their cultural practices, are likely to increase the cost of maintenance (Al-Arjani, 1995).

3.7 Factors Related to the Management of the Maintenance Department

Maintenance management department is very significant source of managing and executing maintenance work during different stages of maintaining a facility. The administration and personnel itself has an important role to play in this regard.

3.7.1 Poor Administration of Maintenance Management

For an effective maintenance management department, administration of the maintenance department and the strategies followed by the maintenance department are two vital elements. The cost of having poor management which issues wrong decisions will affect the cost of maintenance. Effective maintenance management should have a clear strategy for corrective, preventive and condition-based maintenance (Horner et al., 1997).

3.7.2 Lack of Documentation on the Maintenance Work

For future maintenance of similar work, documentation of maintenance work is essential. This documentation could be used as a base for prospective maintenance to avoid implementing procedure that would result in high cost of maintenance (Lam, 2001). Documentation of maintenance work provides for effective accounting procedures for the contractor.

3.7.3 Outsourcing of the Maintenance Services

Outsourcing has become a significant facet of modern hotel management. It is very important to understand how hotels' motivation for outsourcing is important. Hotel

operators consider that outsourcing has great potential to improve cost, strategy and performance, and thus squeeze operating costs in a tough business environment (Chang et al., 2008).

3.7.4 Lack of Well-Trained Maintenance Personnel

The availability of properly trained personnel in the type of maintenance work is necessary for completing the work correctly. Poorly trained staff would result in the performance of defective work, reduced productivity and accidents. Ultimately, these consequences will contribute to a high maintenance cost (Colen, & Lambrecht, 2012).

3.7.5 Health and Safety Requirements

Like other factors, health and safety requirements also influence maintenance works to a great extent (Hon Yin Lee, & Scott, 2009). Maintenance work is not only a leading to risk for maintenance workers but also for building users as well. Therefore, all building stakeholders, particularly managers, are responsible for ensuring safety and health assessment as well as a documented safety work procedure which should be used as guidance for maintenance workers. (A. S. Ali, 2008) and (Hashim, 2004).

Table 3-1: Summary of factors outlined form literature review

No.	Factors affecting the operation and maintenance cost of hotels	Author(s)
1	Design problems	Wordsworth, 2007; Al-Shiha 1993; and Olubodun and Mole,1999
2	Building age	Ali et al., 2010; Olubodun and Mole,1999; and Al-Khatam, 2003
3	Floor area	Chan et al. 2003
4	Star raging of the hotel	Chan et al. 2003
5	Guestroom (Nos.)	Chan et al. 2003
6	Materials used for interior finishes	Al-Khatam, 2003
7	Usage of new materials or ignorance of materials' properties	Mahmoud, 1994
8	Building height and structure	Ali et al., 2010; and Neves et al., 2004
9	Materials used for exterior finishes	Al-Khatam, 2003
10	Poor Quality Control	Ali et al., 2010, El-Haram and Horner, 2002 and Mohamoud, 1994
11	Low Concern to Future Maintenance	Patton, 1988
12	Failure to Identify the True Cause of Defect	Wordsworth, 2000
13	Inadequate Standard and Specification	Patton, 1988; and Seeley, 1987
14	Harsh Climatic Conditions	Patton, 1988
15	Equipment	Al-Hammad et al., 1996; and Ali et al., 2010 and El-Haram and Horner, 2002
16	Unavailability of skilled laborers	Al-Khudair, 1988

Table 3-1 (continued)

No.	Factors affecting the operation and maintenance cost of hotels	Author(s)
17	Faulty workmanship in the initial construction	Al-Khatam, 2003; and Mills, 1980
18	Uneducated Labors	Shear, 1983
19	Unfamiliarity with the use of technology	(Hassanain et al., 2013)
20	Poor performance of the maintenance group	(Azmy, 2012)
21	Poor communication between the maintenance group and the users	(Choon Hua et al., 2005)
22	Inadequate Finance for maintenance work	Moua and Russell, 2001; El-Haram and Horner, 2002; and Ali et al., 2010
23	Poor Financial Control when executing maintenance work	Al-Juwairah, 1997
24	Failure to forecast the accurate maintenance expenditures	(Christian, & Pandeya, 1997)
25	Inflation of maintenance cost	(Hassanain et al., 2013)
26	End users' behavior	Al-khatam, 2003
27	Customer satisfaction	Chan et al. 2003
28	Occupancy rate	Lai and Yik, 2008; Damonte et al., 1997; and Johns et al., 1997
29	Cultural practices	Al-Arjani, 1995
30	Poor administration of maintenance management group	Horner et al., 1997
31	Lack of documentation on the maintenance work	Lam, 2001
32	Outsourcing of the maintenance services	Chang et al., 2008
33	Lack of well-trained maintenance personnel	Colen and Lambrecht, 2012
34	Maintenance type (e.g. routine, corrective)	Chan et al. 2003
35	Safety and health requirements	Hon Yin Lee & Scott, 2009; Ali 2008; and Hashim, 2004

CHAPTER 4

RESEARCH METHODOLGY

To achieve the objectives of this research, following main activates have to be carried out. The research aimed at two main objectives namely; identifying and assessment factors affecting the operation and maintenance cost of hotels in the eastern province of Saudi Arabia and comparing the results for three, four and five star hotels. The objectives are limited to at least three star hotels as well as to the eastern part of Saudi Arabia.

Thirty-five factors were outlined from the literature and eleven factors were collected through interviews with a selected group of engineering/maintenance managers of hotels. All forty-six factors combined and a web-based questionnaire was developed to collect the data. Five point Likert scale was used to evaluate each factor's importance and its impact on the whole operation and maintenance cost. The questionnaire then sent to a population of 47 hotels' engineering/maintenance managers. The gathered data through the questionnaires were statistically analyzed and all the factors ranked according to Relative Importance Index (RII). Based on the analysis and results, conclusion has been drawn and recommendations outlined.

4.1 Interviewing the Engineering/Maintenance Managers

Interviews have been conducted with a group of engineering/maintenance managers to get their feedback regarding the factors affecting the operation and maintenance cost of hotel facilities. First of all, the date for interviews arranged through emails, phone numbers and visiting the hotels. Total ten experts interviewed from four and five star hotels on appointed

dates (see Appendix D). A set of thirteen factors were outlined from interviews of engineering and maintenance managers. These factors cultivated in questionnaires together with factors that collected from literature review.

Secondly, the developed questionnaire piloted with operation and maintenance experts i.e. engineering and maintenance managers. The feedback from piloting suggested some changes in questionnaire for example, removing two factors that were collected through interview (users' education level and gender of the users) and some other modifications have been done to the questionnaire format to make it more clearer and easy-to-understand.

Finally, after the piloting and modification of the questionnaire, the questionnaire organized with total forty-six factors including 35 factors from literature review and finally, 11 factors from interviews with engineering/maintenance managers collected in Table 4-2. In order to collect the data, the piloted questionnaire distributed into the whole targeted population of three, four and five star hotels.

4.2 Developing Questionnaire for Data Collection

A web based questionnaire was developed to speed up the collection of data. A stumped and signed recommendation letter from the department of Architectural Engineering of KFUPM also attached to the questionnaire to make the case more reliable and stronger (see Appendix A). The questionnaire has mainly four sections, which are;

1. The purpose
2. Personal information of the respondent
3. General information about the hotel and
4. Evaluation of the factors affecting the operation and maintenance cost.

A brief guide and the purpose of the questionnaire described in the first section which is the purpose of the questionnaire. In the second section, personal information of the respondent required from the respondent which in this case maintenance manager or engineering director or manager are targeted. In third section, general information about the hotel such as name, star rating, age and location of the hotel are asked to be answered by the respondent.

Last but not the least is the section fourth which is the main and important one entitled "evaluation of factors affecting the maintenance cost". In this section of the questionnaire, respondents are provided with a list of all 46 factors under ten categories which gained from review of literature and interviews. The factors gained from the literature are 35 placed in Table 4-2 and the factors outlined from the interviews with a selected group of operation and maintenance managers who have long experience in this field, collected in Table 4-3 with a sum of 11. A questionnaire finally proposed from combining both, literature and interviews which has mentioned with four sections and ten main categories namely:

1. Technical factors which affect the maintenance cost,
2. Factors related to the maintenance management department,
3. Factors relating to the operations conducted by the maintenance group,
4. Factors relating to the architectural design,
5. Factors relating to the budgetary estimates and economy,
6. Factors relating to the costumers or users,
7. Factors relating to the labor
8. Factors relating to the material being used in maintenance work,

9. Factors relating to the energy being consumed to keep hotel running, and
10. Factors relating to the environment and surrounding (See Appendix B).

4.3 Piloting the Questionnaire

It is very important to identify latent problems before the expensive, time-consuming, full-scale research is commenced. Initial, small-scale studies (pilots) help to identify how the questions are likely to be interpreted. Piloting will provide a guide for replacing or rephrasing questions to invite a richer response.

As discussed before, after designing and developing the questionnaire, it was piloted with a group of 5 experts to achieve the goal of having richer responses. All of five experts had a long experience in the hotel maintenance and engineering related field with an average of 21-year experience. Two factors (Gender of the users and Education level of the users) out of 13 outlined form interviews has been removed and the organization and clarity of the questionnaire was approved by all experts with very small changes overall. Indeed, some phrases and factors are modified to be more clearer and easy to understand. The list of the experts and their experience who piloted the questionnaire is represented in Table 4-1. Also, flowchart of research methodology or map of the research provided in the end of this chapter in Figure 4-1.

Table 4-1: List of experts to whom questionnaire was piloted.

No	Position of the expert	Years of experience	Name of the hotel	Star rating of the hotel
1	Chief Engineer	23	Algosaibi	5 Star
2	Director of engineering	18	Sofitel Alkhobar	5 Star
3	Director of Engineering	22	Crowne Plaza	5 Star
4	Chief of Engineering	17	Coral Hotel	5 Star
5	Engineering Manager	25	Le Meridien	5 Star

Table 4-2: Factors outlined from literature review

No.	Factors affecting the operation and maintenance cost of hotels
1	Design problems
2	Building age
3	Floor area
4	Star raging of the hotel
5	Guestroom (Nos.)
6	Materials used for interior finishes
7	Usage of new materials or ignorance of materials' properties
8	Building height and structure
9	Materials used for exterior finishes
10	Poor Quality Control
11	Low Concern to Future Maintenance
12	Failure to Identify the True Cause of Defect
13	Inadequate Standard and Specification
14	Harsh Climatic Conditions
15	Equipment

Table 4-2 continued…

No.	Factors affecting the operation and maintenance cost of hotels
16	Unavailability of skilled laborers
17	Faulty workmanship in the initial construction
18	Uneducated Labors
19	Unfamiliarity with the use of technology
20	Poor performance of the maintenance group
21	Poor communication between the maintenance group and the users
22	Inadequate Finance for maintenance work
23	Poor Financial Control when executing maintenance work
24	Failure to forecast the accurate maintenance expenditures
25	Inflation of maintenance cost
26	End users' behavior
27	Customer satisfaction
28	Occupancy rate
29	Cultural practices
30	Poor administration of maintenance management group
31	Lack of documentation on the maintenance work
32	Outsourcing of the maintenance services
33	Lack of well-trained maintenance personnel
34	Maintenance type (e.g. routine, corrective)
35	Safety and health requirements

Table 4-3: Factors outlined from maintenance expert interviews

No.	Factors affecting the operation and maintenance cost of hotels
1	Shape of the building (e.g. simple or complicated)
2	Number of stories
3	Glass and Non-glass façade
4	Age of the users, (senior, young or children)
5	Annual energy consumption rate
6	Availability of the materials
7	Efficient energy consuming equipment (e.g. energy star products)
8	Moving toward sustainability and renewable energy sources
9	Lac k of awareness about the importance of maintenance
10	Taxation (e.g. increase in oil prices due to government financial policies)
11	Greenery of indoor and outdoor environment

Shown in Table 4-4, a five-point Likert scale is used for evaluation of the factors. Each factor is ranked from minimum of 1, which show the lowest importance of a factor and maximum of 5 which means very significant and important in affecting operation and maintenance cost of a hotel.

Table 4-4: Evaluation terms along with their assigned weight

Assigned Weight	Evaluation term
5	Extremely Important
4	Very Important
3	Important
2	Minor Important
1	Not Important

4.4 Population and Sample Size Determination

The population of this study is restricted to include at least 3-star rating hotels in the eastern province of Saudi Arabia. According to Saudi Commission for Tourism and National Heritage there are 47 registered hotel facilities consist of 14 five star, 15 four star and 18 three star hotels (SCTH, 2016). Respondents from the targeted hotels are expected to provide specific information about the factors affecting the maintenance costs of hotels. The representative sample size of the study is calculated using the equation 4-1. (Kish, 1995).

$$n_0 = \frac{pq}{SEM^2}$$

$$\boldsymbol{n = \frac{pq}{SEM^2\ 1 + \frac{n_0}{N}}} \qquad (4\text{-}1)$$

Where:

$n0$= The first estimated sample size.

p= The probability of picking a response. It is expressed by, decimal equals to 0.5, which reflects that the maximum sample size is 50% of the population.

q = (1- p) which is 0.5.

SEM= The maximum allowed standard error. In this study, it is considered ±10%.

n= The final estimated sample size.

N= The targeted population size.

Using Kish equation, n_0 equals to 25 responses from the inter population. The final estimated sample size is calculated by substituting the n_0 in the second equation. For population of 47 hotels the final size will be as follows:

$$n = \frac{n_0}{1 + \frac{n_0}{N}} = \frac{25}{1 + \frac{25}{47}} = 16.3 \cong 17$$

The final minimum sample size is 17 responses.

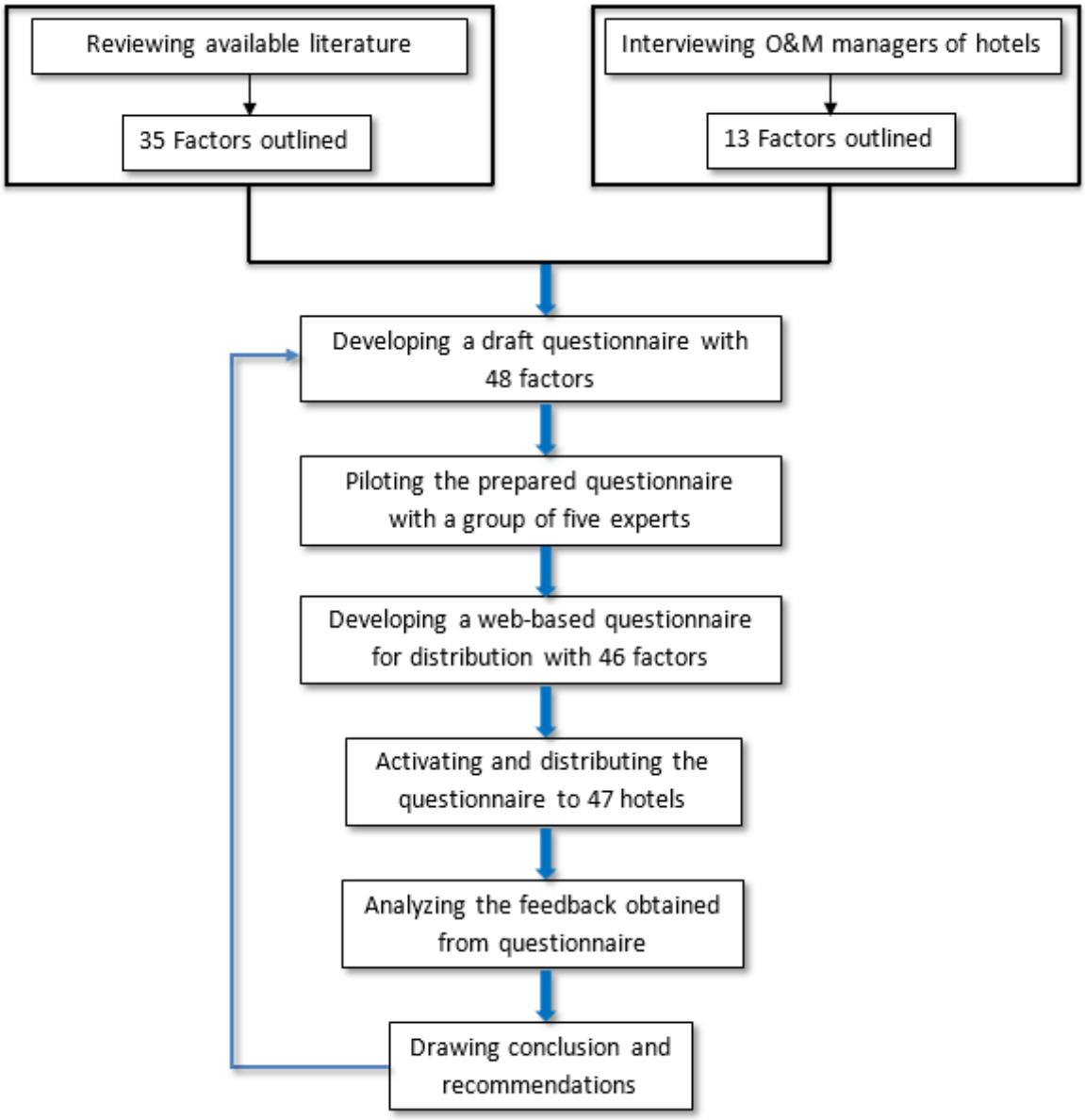

Figure 4-1: Research Methodology flowchart

CHAPTER 5

Analysis and Discussion of the Results

5.1 Introduction

This chapter focuses on the presentation, discussions, findings and analysis of the data and deductions made from the analysis according to the objectives of the study. The field research was conducted in line with the objectives of this research. The obtained data were analyzed with the aid of SPSS (Statistical Package for Social Sciences) version 22 and Microsoft excel. Frequency, percentage, mean, rank, charts and summary tables were used to present the facts from the fieldwork.

5.2 Assessment of Factors Affecting Maintenance Cost of Hotels

This section presents an assessment of the perceived level of importance of each of the 46 factors affecting the cost of operation and maintenance of hotel facilities in Saudi Arabia.

5.2.1 Characteristics of the Respondents

The scope of this study was focused on obtaining responses from the operation and engineering/ maintenance managers of the three, four and five star hotels located in the Eastern Province of Saudi Arabia. According to the official website of Saudi Commission for Tourism and National Heritage, there are 14 five star, 15 four star and 18 three star licensed hotel facilities in the Eastern Province (SCTH, 2016). A good and reliable overall response rate of almost 50% was achieved as the highest form five star hotels with a 57%, 47% for four star hotels and a 45% response rate for three star hotels.

5.2.2 Calculation of Relative Importance index

The gathered responses were assessed and tabulated. The relative importance index (RII) was calculated using equation 5-1:

$$RII = \frac{(100X1 + 75X2 + 50X3 + 25X4 + 0X5)}{(X1 + X2 + X3 + X4 + X5)} \quad (5\text{-}1)$$

Where;

RII is the relative importance index; X1 is the number of respondents opting for “extremely important”; X2 is the number of respondents opting for “very important”; X3 is the number of respondents opting for “important”; X4 is the number of respondents opting for “minor important”; X5 is the number of respondents opting for “not important”.

The ordinal scale utilized in this system is with regular intervals. Each interval is assigned a particular weight, ranging from “extremely important” to being “not important,” as shown in Table 5-1. Additionally, to make sure that the results are accurate and reliable, a rechecking process is applied using Microsoft Excel. Factors were ranked due to Mean values and compared to the SPSS analysis. The results were 100% similar.

Moreover, the data was exported from online google forms into the form of excel sheet. Major analysis work and graphs were prepared and executed in SPSS v22 software (Statistical Package for the Social Sciences) and Microsoft Excel.

Table 5-1: Weighted importance

Level of Importance	**Assigned weight**
Extremely Important	80-100
Very Important	60-79
Important	40-59
Minor Important	20-39
Not Important	0-19

Also, a summary of all 23 responses which shows the frequency of the collected 46 factors for three, four and five star hotels is represented in Table 5-2. As mentioned, respondents ranked the various factors due to their experience with a 5-grade Likert scale. Extremely important for most influencing factors, very important in second position, followed by important, minor important and finally not important as a very low or no significance in influencing the operation and maintenance cost for a specific hotel facility.

Table 5-2: Summary of the responses

Factors	Level of importance															Sum of responses
	1			2			3			4			5			
	3*	4*	5*	3*	4*	5*	3*	4*	5*	3*	4*	5*	3*	4*	5*	
1.					1		5			3	4	2		2	6	
2.				2	1	1	5	4	3	1	2	4				
3.			1	3	2		5	2			3	6			1	
4.			1				1	1	1	4	4	3	3	2	3	
5.			1			1	3		2	3	6		2	1	4	
6.						1	2		1	4	1		2	6	6	
7.				2			6	1	2		5	2		1	4	
8.				3			5	1			2	3		4	5	
9.				2	2	1	6	1	1		3	1		1	5	
10.				1	1	1	3	2		4	2	4		2	3	
11.				2	1	1	5	2	2	1	3	3		1	2	
12.				3		1	5	5	1		2	2			4	23
13.							2	2	3	4		2	2	5	3	
14.	1			5			2	3	2			4		4	2	
15.		1				1	5	2		3	3	1		1	6	
16.				4	1	1	4	2	2		2	1		2	4	
17.	2	1		5			1	2	3		3	1		1	4	
18.			1	2	1		6	2	2		4	4			1	
19.							7	2	3	1	4	2		1	3	
20.							3	2	5	4	4	2	1	1	1	
21.						1	4	2	1	3	4	3	1	1	3	
22.			1			1	1		1	4	4	1	3	3	4	
23.							2		1	4	6	4	2	1	3	

Table 5-2 (continued)

Factors	Level of importance															Sum of responses
	1			2			3			4			5			
	3*	4*	5*	3*	4*	5*	3*	4*	5*	3*	4*	5*	3*	4*	5*	
24.				2			5	1	2	1	4	5		2	1	
25.							2	1	1	4	4	3	2	2	4	
26.							4	4	3	2	2	2	2	1	3	
27.							5	2	2	3	3	3		2	3	
28.							3	5		4	1	3	1	1	5	
29.							3	4		5	3	6			2	
30.	2		3	5	3	2	1	3	2		1	1				
31.				1			2			3	1	2	2	6	6	
32.							1		1	5	2	5	2	5	2	
33.							5		1	1	4	4	2	3	3	
34.							2	2	2	4	2	4	2	3	2	
35.				2			4	5	4	2		3		2	1	23
36.				5	1	1	3	4	3		2	3			1	
37.							4	2	1	4	3	6		2	1	
38.				2			5	2		1	3	5		2	3	
39.							1	2		6	1	1	1	4	7	
40.				1			4		1	3	3	4		4	3	
41.				1			5	2	3	2	2	3		3	2	
42.							3			5	2	2		5	6	
43.							2			3	4	1	3	3	7	
44.				1		1	3		1	4	2			5	6	
45.								1		5	1		3	5	8	
46.							5	1		3	3	3		3	5	

5.2.3 Some Extra Factors Suggested by the Respondents

In the end of the questionnaire survey, space was provided called “Other Factors”. Respondents were asked to add those factors which affect the operation and maintenance cost and it was not included in the list of 46 factors of questionnaire survey. 21% of the respondent (5 respondents) replied to this section and provided al list of factors as following:

1. Building Maintenance Management System (BMMS)
2. Orientation of the building
3. Smartness of management to use available spare parts source
4. Smartness of management to use available manpower source
5. Monthly evaluation of each department
6. Creative staff
7. High quality of needed instruments and spare parts
8. Continuous instructions to the maintenance staff
9. Recycling.

5.3 Discussion of the Results

5.3.1 Experience and Education of the Respondents

The demographical profile of the respondents indicated that 30.4% of the respondents have work experience in the range of more than 20 years, 17.4% have work experience in the interval of 15-20 years, 13% have an experience in the interval of 10-15 years, 21.7% have experience in the interval of 5-10 years and 17.4% have the experience in the range of less than five years. A summary of the experience of the respondents represented in Figure 5-1.

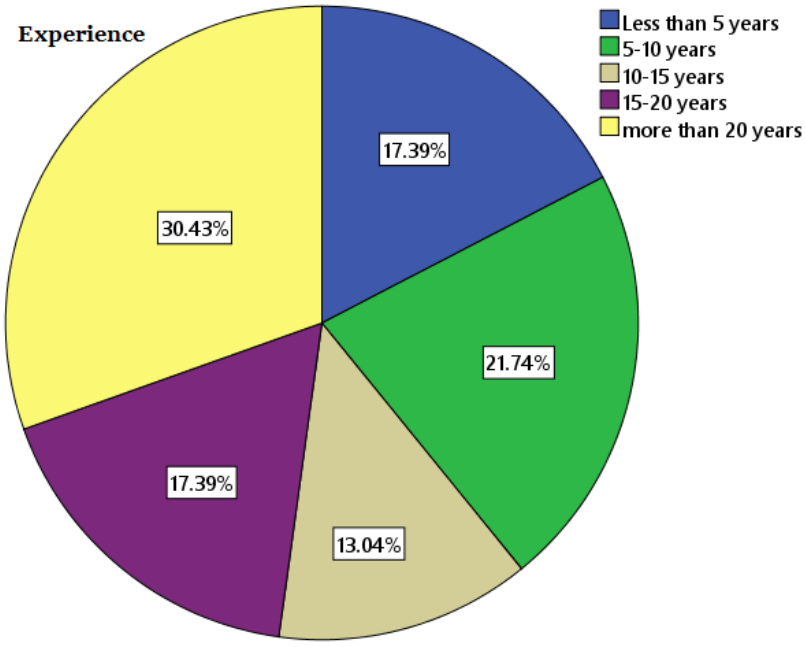

Figure 5-1: Experience of the respondents

Regarding the education level of the respondents, there were three main categories according to their gained degrees which are Bachelor degree with its 56.5% part, professional degree with 26% of its part and technical/training degree with a part of almost 17.5% as presented in Figure 5-2.

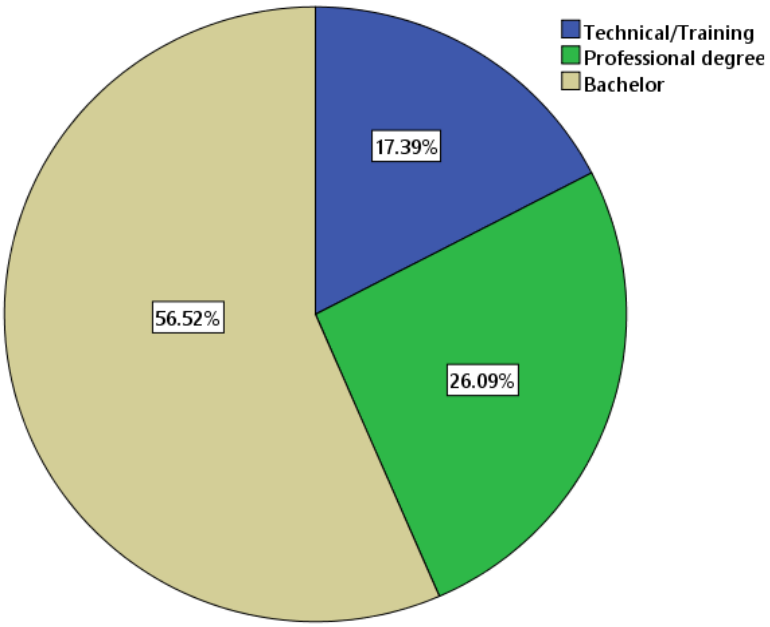

Figure 5-2: Education level of the respondents

5.3.2 Influencing Factors

The positions of the respondents including chief engineer, engineering manager, operation and maintenance manager and maintenance assistant for all three types of hotels; three, four and five star hotels. The respondents ranked the most influencing factors different from each other. The top five factors ranked by the respondent of five star hotels are “climatic conditions” in very first, followed by “availability of the materials”, “efficient energy consuming equipment”, “annual energy consumption rate” and “age of the hotel”.

While respondent from four star hotels ranked the most influencing factors as “star rating of the hotel”, “customer satisfaction”, “occupancy rate”, “efficient energy consuming equipment” and “moving towards sustainability and renewable energy sources.” Here, it is obvious that the mutual concern for the respondents of five and four-star hotels are related to the energy department with a small difference which is “annual energy consumption rate” for five star hotels and “moving towards sustainability and renewable energy sources” for four star hotels although both sides are agreed to use energy efficient equipment to reduce annual energy consumption rate which absolutely reduces the annual operation and maintenance cost for facility.

On the other hand, the top five factors ranked by the respondent from three star hotels have a mutual factor to five star hotels and a mutual factor with four-star hotels. In this case, the highly-ranked factor is similar to five stars which is “climatic conditions” followed by “floor area”, “glass and non-glass façade”, whilst the number fourth highest ranked factor is a mutual one to the four-star hotels which is “occupancy rate” and the last and fifth is then a mutual one to both five and four-star hotels which is also related to the energy department and it is “annual energy consumption rate”. A summary of top five influencing factors represented in Table 5-3.

Table 5-3: Summary of the top five ranked factors by the respondents

	5 star hotels	Mean	4 star hotels	Mean	3 star hotels	Mean
Top five ranked factors	Climatic conditions	5	Star rating of the hotel	4.86	Climatic conditions	4.38
	Availability of the materials	4.88	Customer satisfaction	4.86	Floor area	4.25
	Annual energy consumption rate	4.88	Occupancy rate	4.71	Glass and non-glass façade	4.25
	Efficient energy consuming equipment	4.75	Efficient energy consuming equipment	4.71	Occupancy rate	4.13
	Age of the hotel	4.75	Moving towards sustainability and renewable energy sources	4.7	Annual energy consumption rate	4

5.3.3 Interpretation of the Results

During the study, it was witnessed that the higher the star rating of a hotel, the higher qualified management is responsible for running of individual departments. In this study, the targeted department amongst the hotels was engineering/maintenance. The accurate, quicker, and easier responses were collected from five star hotels firstly and then from four and three stars respectively. The findings show that there are some differences in ranking the factors that influences the operation and maintenance cost of the hotels. For instance, for five star hotels, climatic condition is the first higher ranked factor while this is ranked in third and fourth position in three and four-star hotels respectively. This is because of the overall harsh and hot climatic condition of Eastern Province of Saudi Arabia which negatively influences annual energy consumption rate. Moreover, the five star hotels are well-facilitated and using up to date facilitation technology to satisfy the need of customer, which also results in the higher annual energy consumption rate.

Regarding four-star hotels, “star-rating” factor is the main concern for respondents and was ranked in first position. This is due to the bias of respondents to develop from four-star hotel to a five star one. It shows that there is a strong competition between these hotels. The second and third high ranked factors in four-star hotels are customer satisfaction and occupancy rate, which both are related to customer or occupants. This is because of the lowest reservation of hotels during the summer in which the weather is very hot and humid. Although there is not predominant difference in the rent of four-star hotel compare to five-star hotel, but customer prefer a well facilitated hotel as five star ones which results in difference in customer satisfaction and less occupancy rate for four star hotels. Indeed, annual energy consumption rate remains the mutual concern between the four and five star hotels as they are somehow close to each other in providing facilities and using technology. It can be summarized that the shear concern between all three groups of hotels’ respondents is related to the energy department of the hotels which keep the facility running and provides the indoor air quality to a satisfied and acceptable standard.

Last but not least, due to the average of overall relative importance index for five, four and three star hotels, it can be concluded that the highly ranked five factors are “climatic conditions” chased by “annual energy consumption rate”, “customer satisfaction”, “star rating of the hotel” and “efficient energy consuming equipment”. The results for three, four and five star hotels including, RII, mean and ranking is presented in Tables 5-4, 5-5 and 5-6 respectively. Also, a summary of all three groups of hotels, individually and overall highly ranked factors represented in Tables 5-7.

Table 5-4: Mean, RII and ranks of factors for 3 star hotels

No.	Factors affecting operation and maintenance cost of hotels	Mean	RII	Ranks
Technical factors which affect the maintenance cost				
1	Age of the hotel	3.38	59.38	21
2	Design problem	2.88	46.88	32
3	Low concern to the future maintenance	2.63	40.63	39
4	Floor area	4.25	81.25	2
5	Guest Rooms (Nos)	3.88	71.88	11
6	Star Rating of the hotel	4.00	75.00	6
Factors related to the maintenance management department				
7	outsourcing of maintenance services	2.75	43.75	36
8	Maintenance type (e.g. routine, corrective or preventive)	2.63	40.63	39
9	Poor administration of the maintenance management group	2.75	43.75	36
10	Lac k of documentation of maintenance work	3.38	59.38	21
11	Shortage of properly trained maintenance personnel	2.88	46.88	32
12	Lac k of awareness about the importance of maintenance	2.63	40.63	39
13	Health and safety standards	4.00	75.00	6
Factors relating to the operations conducted by the maintenance group				
14	Unfamiliarity with the use of technology	2.13	28.13	44
15	Use of poor quality spare parts	3.38	59.38	21
16	Poor performance of the maintenance group	2.50	37.50	42
17	Poor communication between the maintenance groups & the users	1.88	21.88	45
18	Unavailability of operation and maintenance manuals	2.75	43.75	36
19	Failure to identify the true causes of defects	3.13	53.13	28
Factors relating to the architectural design				
20	Shape of the building (e.g. simple or complex)	3.75	68.75	12
21	Number of stories	3.63	65.63	16
22	Glass and Non-glass façade	4.25	81.25	2
23	Materials used for interior finishes	4.00	75.00	6
24	Materials used for exterior finishes	2.88	46.88	32
25	Structure type of the building	4.00	75.00	6

Table 5-4 (continued)

No.	Factors affecting operation & maintenance cost of hotels	Mean	RII	Ranks
Factors relating to the budgetary estimates and economy				
26	Insufficient budget allocated for maintenance activities	3.75	68.75	12
27	Lack of mechanisms to control the budget allocated for maintenance	3.38	59.38	21
28	Failure to forecast the accurate maintenance expenditures	3.75	68.75	12
29	Inflation of maintenance cost	3.63	65.63	16
30	Taxation	1.88	21.88	45
Factors relating to the costumers or users				
31	Customer Satisfaction	3.75	68.75	12
32	Occupancy Rate	4.13	78.13	4
33	Occupants' or users' attitude	3.63	65.63	16
34	Cultural differences	4.00	75.00	6
35	Age of the users, (senior, young or children)	3.00	50.00	30
Factors relating to the material being used in maintenance work				
36	Uneducated labor	2.38	34.38	43
37	Availability of skilled labor	3.50	62.50	20
38	Faulty Workmanship	2.88	46.88	32
Factors relating to the material being used in maintenance work				
39	Availability of the materials	4.00	50.00	30
40	Quality of the materials	3.25	56.25	27
41	Ignorance of materials' properties	3.13	53.13	28
Factors relating to the energy being consumed to keep the hotel running				
42	Efficient energy consuming equipment (e.g. energy star products)	3.63	65.63	16
43	Annual energy consumption rate	4.13	78.13	4
44	Moving towards sustainability and renewable energy sources	3.38	59.38	21
Factors relating to the environment and surrounding				
45	Climatic conditions	4.38	84.38	1
46	Greenery of indoor and outdoor environment	3.38	59.38	21

Table 5-5: Mean, RII and ranks of factors for 4 star hotels

No.	Factors affecting operation and maintenance cost of hotels	Mean	RII	Ranks
	Technical factors which affect the maintenance cost			
1	Age of the hotel	4.00	75.00	23
2	Design problem	3.14	53.57	43
3	Low concern to the future maintenance	3.14	53.57	43
4	Floor area	4.14	78.57	15
5	Guest Rooms (Nos)	4.14	78.57	15
6	Star Rating of the hotel	4.86	96.43	1
	Factors related to the maintenance management department			
7	outsourcing of maintenance services	4.00	75.00	23
8	Maintenance type (e.g. routine, corrective or preventive)	4.43	85.71	8
9	Poor administration of the maintenance management group	3.43	60.71	36
10	Lac k of documentation of maintenance work	3.71	67.86	31
11	Shortage of properly trained maintenance personnel	3.57	64.29	33
12	Lac k of awareness about the importance of maintenance	3.29	57.14	42
13	Health and safety standards	4.43	85.71	8
	Factors relating to the operations conducted by the maintenance group			
14	Unfamiliarity with the use of technology	4.14	78.57	15
15	Use of poor quality spare parts	3.43	60.71	36
16	Poor performance of the maintenance group	3.71	67.86	31
17	Poor communication between the maintenance groups & the users	3.43	60.71	36
18	Unavailability of operation and maintenance manuals	3.43	60.71	36
19	Failure to identify the true causes of defects	3.86	71.43	28
	Factors relating to the architectural design			
20	Shape of the building (e.g. simple or complex)	3.86	71.43	28
21	Number of stories	3.86	71.43	28
22	Glass and Non-glass façade	4.43	85.71	8
23	Materials used for interior finishes	4.14	78.57	15
24	Materials used for exterior finishes	4.14	78.57	15
25	Structure type of the building	4.14	78.57	15

Table 5-5 (continued)

No.	Factors affecting operation & maintenance cost of hotels	Mean	RII	Ranks
	Factors relating to the budgetary estimates and economy			
26	Insufficient budget allocated for maintenance activities	3.57	64.29	33
27	Lack of mechanisms to control the budget allocated for maintenance	4.00	75.00	23
28	Failure to forecast the accurate maintenance expenditures	3.43	60.71	36
29	Inflation of maintenance cost	3.43	60.71	36
30	Taxation	2.71	42.86	46
	Factors relating to the costumers or users			
31	Customer Satisfaction	4.86	96.43	1
32	Occupancy Rate	4.71	92.86	3
33	Occupants' or users' attitude	4.43	85.71	8
34	Cultural differences	4.14	78.57	15
35	Age of the users, (senior, young or children)	3.57	64.29	33
	Factors relating to the material being used in maintenance work			
36	Uneducated labor	3.14	53.57	43
37	Availability of skilled labor	4.00	75.00	23
38	Faulty Workmanship	4.00	75.00	23
	Factors relating to the material being used in maintenance work			
39	Availability of the materials	4.29	82.14	13
40	Quality of the materials	4.57	89.29	6
41	Ignorance of materials' properties	4.14	78.57	15
	Factors relating to the energy being consumed to keep the hotel running			
42	Efficient energy consuming equipment (e.g. energy star products)	4.71	92.86	3
43	Annual energy consumption rate	4.43	85.71	8
44	Moving towards sustainability and renewable energy sources	4.71	92.86	3
	Factors relating to the environment and surrounding			
45	Climatic conditions	4.57	89.29	6
46	Greenery of indoor and outdoor environment	4.29	82.14	13

Table 5-6: Mean, RII and ranks of factors for 5 star hotels

No.	Factors affecting operation and maintenance cost of hotels	Mean	RII	Ranks
	Technical factors which affect the maintenance cost			
1	Age of the hotel	4.75	93.75	4
2	Design problem	3.38	59.38	45
3	Low concern to the future maintenance	3.75	68.75	37
4	Floor area	3.88	71.88	34
5	Guest Rooms (Nos)	3.63	65.63	40
6	Star Rating of the hotel	4.38	84.38	11
	Factors related to the maintenance management department			
7	outsourcing of maintenance services	4.25	81.25	15
8	Maintenance type (e.g. routine, corrective or preventive)	4.63	90.63	7
9	Poor administration of the maintenance management group	4.25	81.25	15
10	Lac k of documentation of maintenance work	4.13	78.13	21
11	Shortage of properly trained maintenance personnel	3.75	68.75	37
12	Lac k of awareness about the importance of maintenance	4.13	78.13	21
13	Health and safety standards	4.00	75.00	26
	Factors relating to the operations conducted by the maintenance group			
14	Unfamiliarity with the use of technology	4.00	75.00	26
15	Use of poor quality spare parts	4.50	87.50	10
16	Poor performance of the maintenance group	4.00	75.00	26
17	Poor communication between the maintenance groups & the users	4.13	78.13	21
18	Unavailability of operation and maintenance manuals	3.50	62.50	42
19	Failure to identify the true causes of defects	4.00	75.00	26
	Factors relating to the architectural design			
20	Shape of the building (e.g. simple or complex)	3.50	62.50	42
21	Number of stories	4.00	75.00	26
22	Glass and Non-glass façade	3.75	68.75	37
23	Materials used for interior finishes	4.25	81.25	15
24	Materials used for exterior finishes	3.88	71.88	34
25	Structure type of the building	4.38	84.38	11

Table 5-6 (continued)

No.	Factors affecting operation & maintenance cost of hotels	Mean	RII	Ranks
	Factors relating to the budgetary estimates and economy			
26	Insufficient budget allocated for maintenance activities	4.00	75.00	26
27	Lack of mechanisms to control the budget allocated for maintenance	4.13	78.13	21
28	Failure to forecast the accurate maintenance expenditures	4.63	90.63	7
29	Inflation of maintenance cost	4.25	81.25	15
30	Taxation	2.13	28.13	46
	Factors relating to the costumers or users			
31	Customer Satisfaction	4.75	93.75	4
32	Occupancy Rate	4.13	78.13	21
33	Occupants' or users' attitude	4.25	81.25	15
34	Cultural differences	4.00	75.00	26
35	Age of the users, (senior, young or children)	3.63	65.63	40
	Factors relating to the material being used in maintenance work			
36	Uneducated labor	3.50	62.50	42
37	Availability of skilled labor	4.00	75.00	26
38	Faulty Workmanship	4.38	84.38	11
	Factors relating to the material being used in maintenance work			
39	Availability of the materials	4.88	96.88	2
40	Quality of the materials	4.25	81.25	15
41	Ignorance of materials' properties	3.88	71.88	34
	Factors relating to the energy being consumed to keep the hotel running			
42	Efficient energy consuming equipment (e.g. energy star products)	4.75	93.75	4
43	Annual energy consumption rate	4.88	96.88	2
44	Moving towards sustainability and renewable energy sources	4.38	84.38	11
	Factors relating to the environment and surrounding			
45	Climatic conditions	5.00	100.00	1
46	Greenery of indoor and outdoor environment	4.63	90.63	7

Table 5-7: Mean values and ranks of factors affecting operation and maintenance cost of hotels.

No.	Factors affecting operation and maintenance cost of hotels	5 star Mean	5 star Ranks	4 star Mean	4 star Ranks	3 star Mean	3 star Ranks	Overall RII	Overall Rank
	Technical factors which affect the maintenance cost								
1	Age of the hotel	4.75	4	4.00	23	3.38	21	76.09	15
2	Design problem	3.38	45	3.14	43	2.88	32	53.26	43
3	Low concern to the future maintenance	3.75	37	3.14	43	2.63	39	54.35	42
4	Floor area	3.88	34	4.14	15	4.25	2	77.17	12
5	Guest Rooms (Nos)	3.63	40	4.14	15	3.88	11	71.74	20
6	Star Rating of the hotel	4.38	11	4.86	1	4.00	6	84.78	4
	Factors related to the maintenance management department								
7	outsourcing of maintenance services	4.25	15	4.00	23	2.75	36	66.30	32
8	Maintenance type (e.g. routine, corrective or preventive)	4.63	7	4.43	8	2.63	39	71.74	21
9	Poor administration of the maintenance management group	4.25	15	3.43	36	2.75	36	61.96	35
10	Lac k of documentation of maintenance work	4.13	21	3.71	31	3.38	21	68.48	28
11	Shortage of properly trained maintenance personnel	3.75	37	3.57	33	2.88	32	59.78	36
12	Lac k of awareness about the importance of maintenance	4.13	21	3.29	42	2.63	39	58.70	40
13	Health and safety standards	4.00	26	4.43	8	4.00	6	78.26	8
	Factors relating to the operations conducted by the maintenance group								
14	Unfamiliarity with the use of technology	4.00	26	4.14	15	2.13	44	59.78	37
15	Use of poor quality spare parts	4.50	10	3.43	36	3.38	21	69.57	25
16	Poor performance of the maintenance group	4.00	26	3.71	31	2.50	42	59.78	38
17	Poor communication between the maintenance groups & the users	4.13	21	3.43	36	1.88	45	53.26	44
18	Unavailability of operation and maintenance manuals	3.50	42	3.43	36	2.75	36	55.43	41
19	Failure to identify the true causes of defects	4.00	26	3.86	28	3.13	28	66.30	33
	Factors relating to the architectural design								
20	Shape of the building (e.g. simple or complex)	3.50	42	3.86	28	3.75	12	67.39	30
21	Number of stories	4.00	26	3.86	28	3.63	16	70.65	22
22	Glass and Non-glass façade	3.75	37	4.43	8	4.25	2	78.26	9
23	Materials used for interior finishes	4.25	15	4.14	15	4.00	6	78.26	10
24	Materials used for exterior finishes	3.88	34	4.14	15	2.88	32	65.22	34
25	Structure type of the building	4.38	11	4.14	15	4.00	6	79.35	7

Table 5-7 (continued)

No.	Factors affecting operation and maintenance cost of hotels	5 star Mean	5 star Ranks	4 star Mean	4 star Ranks	3 star Mean	3 star Ranks	Overall RII	Overall Rank
	Factors relating to the budgetary estimates and economy								
26	Insufficient budget allocated for maintenance activities	4.00	26	3.57	33	3.75	12	69.57	26
27	Lack of mechanisms to control the budget allocated for maintenance	4.13	21	4.00	23	3.38	21	70.65	23
28	Failure to forecast the accurate maintenance expenditures	4.63	7	3.43	36	3.75	12	73.91	19
29	Inflation of maintenance cost	4.25	15	3.43	36	3.63	16	69.57	27
30	Taxation	2.13	46	2.71	46	1.88	45	30.43	46
	Factors relating to the costumers or users								
31	Customer Satisfaction	4.75	4	4.86	1	3.75	15	85.87	3
32	Occupancy Rate	4.13	21	4.71	3	4.13	4	82.61	6
33	Occupants' or users' attitude	4.25	15	4.43	8	3.63	16	77.17	13
34	Cultural differences	4.00	26	4.14	15	4.00	6	76.09	16
35	Age of the users, (senior, young or children)	3.63	40	3.57	33	3.00	30	59.78	39
	Factors relating to the material being used in maintenance work								
36	Uneducated labor	3.50	42	3.14	43	2.38	43	50.00	45
37	Availability of skilled labor	4.00	26	4.00	23	3.50	20	70.65	24
38	Faulty Workmanship	4.38	11	4.00	23	2.88	32	68.48	29
	Factors relating to the material being used in maintenance work								
39	Availability of the materials	4.88	2	4.29	13	4.00	30	76.09	17
40	Quality of the materials	4.25	15	4.57	6	3.25	27	75.00	18
41	Ignorance of materials' properties	3.88	34	4.14	15	3.13	28	67.39	31
	Factors relating to the energy being consumed to keep the hotel running								
42	Efficient energy consuming equipment (e.g. energy star products)	4.75	4	4.71	3	3.63	16	83.69	5
43	Annual energy consumption rate	4.88	2	4.43	8	4.13	4	86.96	2
44	Moving towards sustainability and renewable energy sources	4.38	11	4.71	3	3.38	21	78.26	11
	Factors relating to the environment and surrounding								
45	Climatic conditions	5.00	1	4.57	6	4.38	1	91.30	1
46	Greenery of indoor and outdoor environment	4.63	7	4.29	13	3.38	21	77.17	14

5.3.4 Contribution of the Experts to the Results

The results of the study shared with experts in order to get their opinions in terms of how beneficial these results are and what do these results mean to them. The feedback of the experts regarding the most influencing factors that affect the operation and maintenance cost of hotels are summarized as below;

- The weather condition affects severely the materials that are used for exterior finishes and the outdoor equipment because of sweltering and high temperature during summer. The reason behind this high weather influence is material selection. Materials are selected as per initials cost apart from standards and specification as well as climatic and environmental requirements.
- Non-availability and no production of the materials that are used for hotels' facilities e.g. items for laundry, kitchen, and gym, inside the Saudi Arabia caused to import most of these materials from outside the country. In addition, no competition in the market which leads the high expenditures for operation and maintenance of hotel.
- Customer satisfaction is another most important factor. The O&M managers uses internet-based satisfaction surveys and social media to get customers' feedback and serve as per customer demand. Customers write reviews and explain their experience with the hotel frankly. The management team tries to keep a good image for the hotel and fulfill the customers' requirements as per the feedback.

Nature or type of maintenance practice is also one of most important factors. Its relationship to the customer satisfaction is significant. To keep the costumer satisfied, it is

recommended to execute the preventive maintenance though it is mostly expensive but effective practice in satisfying present customer and attracting new customers.

5.3.5 Analysis for Agreements of Ranks

The Kendall coefficient of Concordance (*W*) is the statistic, which is used to measure to understand how good an agreement among groups of ranks apart from number of ranks is. This coefficient varies between zero to 1 which indicates that W=1 a good agreement between a set or ranks and W=0 shows no agreement between sets of ranks. Kendall coefficient of Concordance is calculated using the equation 5-2.

$$\boldsymbol{W = \frac{\sum_{i=1}^{n}(R_i - R)^2}{n\,(n^2 - 1)/12}} \qquad (5\text{-}2)$$

Where;

n= number of factors

R_i= the mean ranks assigned to each factor,

R= grand mean or average of all the means assigned to all factors, for example, here in our study;

$\mathbf{R = \sum_{i=1}^{46}(R_i - R)^2}$, $R= (R_1+R_2+R_3+R_4+\ldots+R_n)/n$

In this case, $R= (R_1+R_2+R_3+R_4+\ldots+R_{36})/46 = 25.99$

$\sum_{i=1}^{46}(R_i - R)^2 = 5750.61$

Kendall coefficient of Concordance: $W = \frac{5750.61}{46(46^2-1)/12} = 0.61$

Ranks for each factor were calculated and compared between three types of the respondents using Kendall Concordance analysis. Mean of ranks and overall ranking assigned to each factor was calculated and shown in Table 5-8.

Table 5-8: Overall Ranking of the factors

No.	Factors	3 Star ranks	4 Star ranks	5 Star ranks	Mean of Ranks	Ri-R	$(Ri-R)^2$
1.	Age of the hotel	21	23	4	16.00	-7.50	56.25
2.	Design problem	32	43	45	40.00	16.50	272.25
3.	Low concern to the future maintenance	39	44	37	40.00	16.50	272.25
4.	Floor area	2	15	34	17.00	-6.50	42.25
5.	Guest Rooms (Nos)	11	16	40	22.33	-1.17	1.36
6.	Star Rating of the hotel	6	1	11	6.00	-17.5	306.25
7.	outsourcing of maintenance services	36	24	15	25.00	1.50	2.25
8.	Maintenance type (e.g. routine, corrective or preventive)	40	8	7	18.33	-5.17	26.69
9.	Poor administration of the maintenance management group	37	36	16	29.67	6.17	38.03
10.	Lac k of documentation of maintenance work	22	31	21	24.67	1.17	1.36
11.	Shortage of properly trained maintenance personnel	33	33	38	34.67	11.17	124.69
12.	Lac k of awareness about the importance of maintenance	41	42	22	35.00	11.50	132.25
13.	Health and safety standards	7	9	26	14.00	-9.50	90.25
14.	Unfamiliarity with the use of technology	44	17	27	29.33	5.83	34.03
15.	Use of poor quality spare parts	23	37	10	23.33	-0.17	0.03
16.	Poor performance of the maintenance group	42	32	28	34.00	10.50	110.25
17.	Poor communication between the maintenance groups & the users	45	38	23	35.33	11.83	140.03
18.	Unavailability of operation and maintenance manuals	38	39	42	39.67	16.17	261.36
19.	Failure to identify the true causes of defects	28	28	29	28.33	4.83	23.36
20.	Shape of the building (e.g. simple or complex)	12	29	43	28.00	4.50	20.25
21.	Number of stories	16	30	30	25.33	1.83	3.36
22.	Glass and Non-glass façade	3	10	39	17.33	-6.17	38.03
23.	Materials used for interior finishes	8	18	17	14.33	-9.17	84.03

Table 5-8 (continued)

No.	Factors	3 Star ranks	4 Star ranks	5 Star ranks	Mean of Ranks	Ri-R	$(Ri-R)^2$
24.	Materials used for exterior finishes	34	19	35	29.33	5.83	34.03
25.	Structure type of the building	9	20	12	13.67	-9.83	96.69
26.	Insufficient budget allocated for maintenance activities	13	34	31	26.00	2.50	6.25
27.	Lack of mechanisms to control the budget allocated for maintenance	24	25	24	24.33	0.83	0.69
28.	Failure to forecast the accurate maintenance expenditures	14	40	8	20.67	-2.83	8.03
29.	Inflation of maintenance cost	17	41	18	25.33	1.83	3.36
30.	Taxation	46	46	46	46.00	22.50	506.25
31.	Customer Satisfaction	15	2	5	7.33	-16.17	261.36
32.	Occupancy Rate	4	3	25	10.67	-12.83	164.69
33.	Occupants' or users' attitude	18	11	19	16.00	-7.50	56.25
34.	Cultural differences	10	21	32	21.00	-2.50	6.25
35.	Age of the users, (senior, young or children)	30	35	41	35.33	11.83	140.03
36.	Uneducated labor	43	45	44	44.00	20.50	420.25
37.	Availability of skilled labor	20	26	33	26.33	2.83	8.03
38.	Faulty Workmanship	35	27	13	25.00	1.50	2.25
39.	Availability of the materials	31	13	2	15.33	-8.17	66.69
40.	Quality of the materials	27	6	20	17.67	-5.83	34.03
41.	Ignorance of materials' properties	29	22	36	29.00	5.50	30.25
42.	Efficient energy consuming equipment (e.g. energy star products)	19	4	6	9.67	-13.83	191.36
43.	Annual energy consumption rate	5	12	3	6.67	-16.83	283.36
44.	Moving towards sustainability and renewable energy sources	25	5	14	14.67	-8.83	78.03
45.	Climatic conditions	1	7	1	3.00	-20.50	420.25
46.	Greenery of indoor and outdoor environment	26	14	9	16.33	-7.17	51.36
	Total				21.01		5750.61

5.3.6 Testing of Kendall Coefficient of Concordance

To test significance and validate of analysis by Kendall Coefficient of concordance, chi-square test values are used. Chi-square test is a useful tool to test alternative hypothesis. The null hypothesis, was framed as ranks in three types of hotels are not related. The value of alternative hypothesis will help in rejecting or accepting the null hypothesis. Chi square value is calculated using equation 5-3 as following:

$$X^2 = K(n-1)W \qquad (5\text{-}3)$$

Where;

X2 = Chi Square value

K= Number of Groups

N= number of factors

W= Kendall Coefficient of Concordance

The Kendall Coefficient value = 0.61 expresses the degree of agreement among the ranks for three types of the hotels. Since the number factors (n=46) is greater than seven, chi-square value is calculated for K=3 (group of respondents) n=46 (Number of factors) and W= 0.61;

$X^2 = K(n-1)W = 3(46-1)0.61 = 82.43$

Referring to the critical values of Chi-square distribution table (Appendix C) with a degree of freedom (DF) 46-1=45. Since in the Chi-square table, there is no value for 45 while available for 40 and 50. Interpolation was used to find the critical value for a 45 degree of freedom. Finally, the critical Chi-square value $X^2 = 73.12$ which is less than the observed value X^2 in a probability of occurrence under the null hypothesis $p<0.05$.

It could be concluded with confidence that the level of agreement among the ranks these three types of the hotels is high. The high probability under alternative hypothesis associated with observed value of *W* allows rejecting the null hypothesis; that the rankings of these three types of hotels are unrelated to each other. This shows there is agreement among the ranks of these three types of the hotels' rankings.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Summary and Conclusion

The present research provides a comprehensive study for identifying and assessing the factors affecting the operation and maintenance cost of hotels in the eastern province of Saudi Arabia. The objectives of the study are limited to at least three star hotels as well as to the eastern province of Saudi Arabia. A six-step multi-phase research methodology were developed and applied to achieve the objective for the research. This study identified the factors affecting the operation and maintenance cost of hotel facilities in Saudi Arabia, which has local and potentially global implications. A systematic comprehensive literature review and interviews with selected operation and engineering/maintenance managers resulted in the identification of the major categories and the factors that have the highest influence on operation and maintenance cost within each category.

Forty-six factors were identified. Thirty-five factors were initially outlined from the literature and eleven factors were collected through interviews with a selected group of engineering/maintenance managers of hotels. A web-based questionnaire was developed to collect the data regarding the importance of the identified factors. Five point Likert scale was used to evaluate each factor's importance and its impact on the whole operation and maintenance cost. A population of 47 operation and engineering/maintenance managers from all three types of hotels; three, four and five-star in the Eastern Province of Saudi Arabia, were requested to rate the importance of 46 factors affecting the operation and

maintenance cost of hotels. The respondents' experience includes; 30.4% more than 20 years, 17.4% in range of 15-20 years, 13% in interval of 10-15 years and 17.4% had experience of less than five years. With an acceptable overall responses rate of almost 50% (23 responses) which is more than calculated minimum required; 17 responses, the importance of factors affecting the operation and maintenance cost of hotels are rated. The gathered data through the questionnaires were statistically analyzed and all the factors ranked according to Relative Importance Index (RII) and mean.

The top ranked factors for five star, four star and three star hotels and their mean values are represented as following:

The most important five factors ranked by the respondents of five star hotels along with their mean values are "climatic conditions, 5" in very first, followed by "availability of the materials, 4.88", "annual energy consumption rate, 4.88", "efficient energy consuming equipment, 4.75" and "age of the hotel, 4.75". While respondents from four star hotels ranked the most influencing factors as "star rating of the hotel, 4.86", "customer satisfaction, 4.86", "occupancy rate 4.71", "efficient energy consuming equipment, 4.71" and "moving towards sustainability and renewable energy sources, 4.70". The highly ranked five factors by the respondents from three star hotels have a mutual factor to five star hotels and a mutual one with the four stars. In this case, the highly-ranked factor is similar to five stars which is "climatic conditions, 4.38" followed by "floor area, 4.25", "glass and non-glass façade, 4.25", whilst the number fourth highest ranked factor is a mutual one to the four-star hotels which is "occupancy rate, 4.13" and the last and fifth is then a mutual one to both five and four-star hotels which is also related to the energy department and it is "annual energy consumption rate with the mean value of 4". It can be

concluded that the common concern between all three groups of hotels' respondents is related to the energy department of the hotels, which keep the facility running and provides the indoor air quality to a satisfied and acceptable standard.

On the other hand, the lowest three factors ranked by the respondents of five star, four star and three star hotels and their mean values are represented as follows: "taxation, 2.13", "design problem, 3.38" and "uneducated labor, 3.50". Similar for four star hotels, they are "taxation, 2.71", "design problem, 3.14" and "uneducated labor, 3.14". Also, the lowest three factors for three star hotels are "taxation, 1.88", poor communication between the maintenance group and the users, 1.88" and "unfamiliarity with the use of technology, 2.13".

For the agreement of ranks among the five, four and three star hotels, the Kendall coefficient of Concordance test was applied which varies between zero and one (1: indicates a good agreement among a set of ranks while 0: shows no agreement between sets of ranks). In this case, it is (W=0.61) which show a good relationship among ranks. Also, to test alternative hypothesis which means, there is a good relationship among the ranks, a useful tool called Chi-square values are used. The values of alternative hypothesis help in accepting or rejecting the null hypothesis which stands for the that there is no relationship among the ranks. In Chi-square test, when the critical value is less than the observed value, the null hypothesis can be rejected with the confidence. In this research, the observed calculated Chi-square value (X^2) is 82.43 while the critical Chi-square value is X^2 =73.12. Since the observed X^2 is greater than the critical X^2, it can be concluded with confidence that there is an agreement among the ranks of these three types of hotels' rankings.

6.2 Recommendations

6.2.1 Recommendations for Maintenance Managers

Due to variation in market price, forecasting and allocating the budget required to carry out the maintenance operations for hotel facilities is difficult and complicated task for the facility managers. To facilitate the task of maintenance managers of hotels in allocation of appropriate and enough amount of budget for operation and maintenance, following recommendations are suggested based on the findings of the study:

1. Weather condition in the Eastern Province of Saudi Arabia has higher fluctuation, which makes a big difference in occupancy rate e.g. the highest during spring and the lowest during summer. It is suggested that the allocated budget should be distributed on season wise during year e.g. more in summer than winter.
2. Budget should be accurately allocated for the time in which occupancy rate is less although the income is lesser. For instance, when the occupancy rate is higher, indeed there is a higher income as well and it is difficult to execute maintenance work in such higher occupancy rate while during lowest occupancy rate, executing the maintenance work is easier. Therefore, the budget should be distributed in proportion to occupancy rates.
3. Facilities should be operated in proportion to occupancy rate during summer when the occupancy rate is in its lowest rate. It is suggested that facilities should be divided into two zones. The first zone should be operated in lowest occupancy rates in summer and the second should be operated in highest occupancy rate. This will definitely help in reducing energy consumption rate which has a direct relationship to the maintenance and its cost for electromechanical equipment.

As for reducing annual energy consumption rate and moving towards sustainable and renewable energy sources, following are recommended:

1. Energy star products and smart electromechanical equipment which work through sensors such as lights and some other electromechanical equipment should be used for less energy consumption.
2. Infiltration should be minimized up to its possible rate by applying various techniques (e.g. using double-glazing system).
3. Developing a clear annual energy reducing plan and a long-term sustainable energy sources plan and following up its application with corresponding departments.
4. Rising the awareness between top and lower staff level management teams regarding the energy consumption can make difference in expenditures.

6.2.2 Recommendation for Future Research

The following areas are recommended for future development:

1. Since this study is limited to the Eastern Province of Saud Arabia, therefore a further research is needed to identify and assess the importance of the factors that affect operation and maintenance cost of hotels in some other major cities such as Makkah, Madinah, and Riyadh of Saudi Arabia.
2. Based on the identified factors in this research, a maintenance cost estimate model can be developed for hotels facilities using actual data collecting from the databases of hotels.

References

1. Al-Arjani, A. H. (1995). Impact of cultural issues on the scheduling of housing maintenance in a Saudi Arabian urban project. *International Journal of Project Management*, *13*(6), 373-382.
2. Al-Juwairah, Y. A. (1997). Factors Affecting Construction Costs in Saudi Arabia. Unpublished Master Thesis, King Fahd University of Petroleum and Minerals, Saudi Arabia.
3. Al-Khatam, J. A. (2003). *Building Maintenanc Cost,(Master of Engineering Report, CEM-600)*. Construction Engineering and Management, KFUPM, Dhahran, Saudi Araiba.
4. Al-Khudair, A. (1988). *Factors Affecting the Maintenance Cost of the Building in Saudi Arabia* (Doctoral dissertation, M. Sc. Thesis Delivered in the Department of Construction Engineering and Management, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia).
5. Al-Shiha, M. M. (1993). *The Effects of Faulty Design and Construction of Building Maintenance* (Doctoral dissertation, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia)).
6. Al-Hammad, A., Al-Mubaiyadh, S., & and Mahmoud, T. (1996). Public versus private sector's assessment of problems facing the building maintenance industry in Saudi Arabia. *Building Research and Information*, *24*(4), 245–254.
7. Ali, A., Kamaruzzaman, S., Sulaiman, R., & Cheong Peng, Y. (2010). Factors affecting housing maintenance cost in Malaysia. *Journal of Facilities Management*, *8*(4), 285–298.

8. Ali, A. S. (2008). Integrative mechanisms in the design process of building refurbishment projects. *Unpublished Thesis, Universiti Teknologi MARA*.
9. Aljazira Capital, (2015). *Saudi Hospitality Sector Report*. Saudi Arabia, p: 6-7.
10. Álvarez Gil, M. ., Burgos Jiménez, J., & Céspedes Lorente, J. . (2001). An analysis of environmental management, organizational context and performance of Spanish hotels. *Omega*, *29*(6), 457–471.
11. Azmy, N. (2012). The Role of Team Effectiveness in Construction Project Teams and Project Performance. *Ph.D Dissertations, Civil, Construction, and Environmental Engineering dept. lowa State University, Ames United States*.
12. British Standards Institution, (BSI). (1993). *BS 3811: 1993, Glossary of Terms Used in Terotechnology*.
13. Capital, A., & Investment, B. (2014). GCC Hospitality Industry Report September 24 , 2014.
14. Chan, K. T., Lee, R. H. K., & Burnett, J. (2001). Maintenance performance: a case study of hospitality engineering systems. *Facilities*, *19*, 494–504.
15. Chan, K. T., Lee, R. H. K., & Burnett, J. (2003). Maintenance Practices and Energy Performance of Hotel Buildings. *Strategic Planning for Energy and the Environment*, *23*(1), 6–28.
16. Chang, C. Y., Huang, S. M., & Guo, S. J. (2008). Setting a priority benchmark for building maintenance in Taiwan's national universities. *Journal of Architectural and Planning Research*, *25*(2), 162–175.

17. Choon Hua, G., Sher, W., & Sui Pheng, L. (2005). Factors affecting effective communication between building clients and maintenance contractors. *Corporate Communications: An International Journal*, *10*(3), 240–251.
18. Christian, J., & Pandeya, A. (1997). Cost Predictions of Facilities. *Journal of Management in Engineering*, *13*(1), 52–61.
19. Colen, P. J., & Lambrecht, M. R. (2012). Cross-training policies in field services. *International Journal of Production Economics*, *138*(1), 76–88.
20. Damonte, L. T., Rompf, P. D., Domke, D. J., & Bahl, R. (1997). Brand affiliation and property size effects on measures of performance in lodging properties. *Hospitality Research Journal*, *20*, 1–16.
21. Don Sapp. (2015). Facilities Operations and Maintenance | Whole Building Design Guide. Retrieved November 16, 2016, from https://www.wbdg.org/om/om.php
22. El-Haram, M. A., & Horner, M. W. (2002). Factors affecting housing maintenance cost. *Journal of Quality in Maintenance Engineering*, *8*(2), 115–123.
23. Genenral Strategy, P. 1. (2003). *The Supreme Commission for Tourism-National Tourism Development Project in KSA*.
24. Hashim, A. E. (2004). *Planning and control of safety in construction refurbishment projects.* UniversitiTeknologi MARA, Malaysia.
25. Hassanain, M. A., Assaf, S., Al-Ofi, K., & Al-Abdullah, A. (2013). Factors affecting maintenance cost of hospital facilities in Saudi Arabia. *Property Management*, *31*(4), 297–310.

26. Hassanien, A., & Losekoot, E. (2002). The application of facilities management expertise to the hotel renovation process. *Facilities*, *20*(7/8), 230–238.
27. Hon Yin Lee, H., & Scott, D. (2009). Strategic and operational factors' influence on the management of building maintenance operation processes in sports and leisure facilities, Hong Kong. *Journal of Retail and Leisure Property*, *8*(1), 25–37.
28. Horner, R. M. W., El-Haram, M. A., & Munns, A. K. (1997). Building maintenance strategy: a new management approach. *Journal of Quality in Maintenance Engineering*, *3*(4), 273-280.
29. ISO 15686-5:08, I. S. O. (2008). Buildings and constructed Assets-Service Life Planning-Part 5 Life Cycle Costing.
30. Johns, N., Howcroft, B., & Drake, L. (1997). The use of data envelopment analysis to monitor hotel productivity. *Progress in Tourism and Hospitality Research*, *3*(2), 119–127.
31. Kish, L. (1995). *Survey Sampling* (Revised Ed). New York, USA.: John Wiley & Sons, Inc.
32. Krstić, H., & Marenjak, S. (2012). Analysis of buildings operation and maintenance costs. *Građevinar*, *64*(4), 293–303.
33. Lai, J. H. K., & Yik, F. W. H. (2008). Benchmarking operation and maintenance costs of luxury hotels. *Journal of Facilities Management*, *6*(4), 279–289.
34. Lam, K. C. (2001). Quality assurance system for quality building services maintenance. In *National Conference, Part 1, The Chartered Institution of Building Service Engineers*.

35. Lateef, O. A. (2009). Building maintenance management in Malaysia. *Journal of Building Appraisal*, *4*(3), 207–214.
36. Mahmoud, T. (1994). *Assessment of the problems facing the maintenance industry in Saudi Arabia* (Doctoral dissertation, Architectural Engineering Dept., KFUPM, Dhahran, Saudi Arabia).
37. Mills, E. D. (1980). *Building maintenance and preservation: a guide for design and management*. Butterworth-Heinemann.
38. Moua, B., & Russell, J. S. (2001). COMPARISON OF TWO MAINTAINABILITY PROGRAMS. *Journal of Construction Engineering and Management*, *127*(3), 239–244.
39. Neves, L. C., Frangopol, D. M., & Cruz, P. S. (2004). Cost of life extension of deteriorating structures under reliability-based maintenance. *Computers and Structures*, *82*(13–14), 1077–1089.
40. Olubodun, F., & Mole, T. (1999). Evaluation of defect influencing factors in public housing in the UK. *Structural Survey*, *17*(3), 170–178.
41. Önüt, S., & Soner, S. (2006). Energy efficiency assessment for the Antalya Region hotels in Turkey. *Energy and Buildings*, *38*(8), 964–971.
42. Patton, J. D. J. (1988). *Maintainability and Maintenance Management* (2nd ed.). North Carolina, U.S.A: Instrument Society of America.
43. Pitt, M., Cannavina, D., Sulaiman, R., Mahyuddin, N., & Wu, C. (2016). Hotel maintenance management in Sanya, China. *Journal of Facilities Management*, *14*(4), 304–314.

44. Reuters, N. and M. (2014). Research and Market. Retrieved from http://www.reuters.com/article/research-and-markets-idUSnBw206654a+100+BSW20140520, accessed on 13. 10. 2016.
45. Richard, C. M., Tse, P., Ling, L., & Fung, F. (2000). Enhancement of maintenance management through benchmarking. *Journal of Quality in Maintenance Engineering*, *6*(4), 224–240.
46. Rydell, C. P. (1970). *Factors affecting maintenance and operating costs in federal public housing projects* (Vol. 634) Rand.
47. Saghatforoush, E., Trigunarsyah, B., & Too, E. (2012). Assessment of Operability and Maintainability Success Factors in Provision of Extended Constructability Principles. *Isfahan-Iran*, *8*(5), 8–10.
48. SCTH. (2014). Saudi hotel market is the largest in the region attracting huge investment opportunities. Retrieved from https://scth.gov.sa/en/mediaCenter/News/GeneralNews/Pages/z-g-1-28-4-14.aspx accessed on 15. 09. 2016.
49. SCTH. (2016). Saudi Commisson for Tourism and National Heritage. Retrieved from https://scth.gov.sa/TourismInvestment/TourismLicensing/Pages/Tour1.aspx accessed on 27. 11. 2016
50. Seeley, I. H. (1987). *Building Maintenance* (2nd ed.). Palgrave.
51. Shear, M. A. (1983). *Handbook of building maintenance management*. Virginia: Reston Publishing Co.
52. Vij, M. (2012). A survey of factors influencing cost structures in the Indian hotel sector. *Worldwide Hospitality and Tourism Themes*, *4*(5), 449–462.

53. Waziri, B. S. (2016). Design and Construction Defects Influencing Residential Building Maintenance in Nigeria. *Jordan Journal of Civil Engineering*, *10*(3).

54. Wordsworth, P. (2000). *Lee's Building Maintenance Management* (4th Editio). Koren Adolph.

55. WTTC. (2017). Travel & tourism: economic impact 2017 (world), p, 24. accessed on 19. 03. 2017.

56. Yik, F. W. H., & Lai, J. H. K. (2007). The trend of outsourcing for building services operation and maintenance in Hong Kong. *Facilities International Journal of Service Industry Management Facilities Facilities*, *23*(12), 63–72.

57. Zainal Abidin, A., Sharifah Hamimah, S., Ismail, A. R., & Maizam, A. (2009). School building maintenance strategy: A new management approach.

Appendices

Appendix A: Department recommendation letter

بسم الله الرحمن الرحيم

Ministry of Higher Education
King Fahd University of Petroleum & Minerals
COLLEGE OF ENVIRONMENTAL DESIGN
ARCHITECTURAL ENGINEERING DEPARTMENT

وزارة التعليم العالي
جامعة الملك فهد للبترول والمعادن
كلية تصاميم البيئة
قسم الهندسة المعمارية

Date: 10/Feb/2016

To Whom It May Concern

This is our student Bakhter Ihsan studying his Master degree in Architectural Engineering Department of King Fahd University of Petroleum & Minerals. He is working on his thesis research titled (***Factors Affecting Operation and Maintenance Cost of Hotels in Saudi Arabia***).

You are kindly requested to help him in this regard. We appreciate your assistance and patience.

Thanks in advance for your cooperation.

Dr. Baqer M. Al-Ramadan
Chairman
Architectural Engineering Department

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Appendix B: Survey questionnaire

Factors Affecting Operation and Maintenance Cost of Hotels

(Survey Questionnaire)

Prepared by: Bakhter Ihsan

King Fahd University of Petroleum and Minerals (KFUPM) Dhahran, 31261, KSA.

A. *The purpose*: الهدف

- The aim of this questionnaire is to study factors affecting operation and maintenance cost of hotels.
- الهدف من هذا الاستبيان دراسة العوامل المؤثرة في اسعار الصيانة والتشغيل في الفنادق
- This study is conducted as a part of master degree thesis at KFUPM University.
- يتم إجراء هذه الدراسة كجزء من أطروحة ماجستير في جامعة الملك فهد للبترول والمعادن
- All information provided will be used only for academic purposes.
- جميع المعلومات المستخدمة هي للاغراض الاكاديمية البحتة
- You are expected be able to provide information regarding the operation and maintenance cost in your hotel
- متوقع منكم تزويدنا بمعلومات بما يختص باسعار التشغيل والصيانة للفندق
- Time estimated to fill the questionnaire is 10 min.
- الوقت المتوقع لاكمال هذا الاستبيان 10 دقيقة
- Thank you from your cooperation
- شكرا لحسن تعاونكم

A. *Personal Information of the respondent:* المعلومات الشخصية

Name (Optional) (اختياري) الاسم	
Education التعليم	(___) Technical/ training التدريب التقني\ المهني (___) Associate degree درجة الدبلوم (___) Bachelor's degree درجة الباكالوريوس (___) Professional degree درجة المهنية (___) Master's degree درجة الماجستير (___) Doctorate degree درجة الدكتوراه (___) Other (Please specify)……..
Position الوظيفة	
Years of experience سنوات الخبرة	□ < 5 □ 5 – 10 □ 10 – 15 □ 15 – 20 □ > 20

B. *General Information about the hotel* معلومات عامة عن الفندق

Name of the hotel (Optional) (اختياري) اسم الفندق	
Star Rating of the hotel (عدد النجوم) تقييم الفندق	
Age of the hotel تاريخ انشاء الفندق	
Location (Name of place) موقع الفندق	
Guest Rooms (Nos) غرف النزلاء	

A. Evaluation of the factors affect the operation and maintenance cost

تقييم العوامل التي تؤثر على اسعار التشغيل والصيانة

Kindly, rank the following factors (1 to 5) whereas 5 = very important and 1= Less important

الرجاء تقييم العوامل التالية , حيث ان 5 = مهمة جدا و 1 = اقل اهمية

	Technical factors which affect the maintenance cost **عوامل فني تؤثر على اسعار الصيانة**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
1	Age of the hotel عمر الفندق					
2	Design problem مشكلة تصميم					
3	Low concern to future maintenance الاهتمام منخفض للصيانة المستقبلية					
4	Floor Area مساحة الطابقية					
5	Guest Rooms (Nos) غرف النزلاء					
6	Star Rating of the hotel تقييم الفندق (النجوم)					
	Factors related to the maintenance management department **عوامل لها علاقة بدائرة ادارة الصيانة**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
7	Outsourcing of maintenance services خدمات الصيانة بمصادر خارجية					
8	Maintenance type (e.g. routine, corrective or preventive) نوع الصيانة (مثال : صيانة روتينية, تصحيحية , وقائية)					
9	Poor administration of the maintenance management group ضعف ادارة قسم ادارة الصيانة					
10	Lac k of documentation of maintenance work نقص في الوثائق الخاصة باعمال الصيانة					
11	Shortage of properly trained maintenance personnel نقص في العمالة المدربة المختصة في اعمال الصيانة					
12	Lac k of awareness about the importance of maintenance نقص الادراك باهمية الصيانة					
13	Health and safety معايير الصحة والسلامة					

Evaluation of the factors affecting O&M cost (continued)

	Factors relating to the operations conducted by the maintenance group **عوامل لها علاقة بالتشغيل المنفذ من قبل وحدة الصيانة**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
14	Unfamiliarity with the use of technology عدم الالمام بالتقنية					
15	Use of poor quality spare parts استخدام معدات بنوعية متدنية					
16	Poor performance of the maintenance group ضعف كفاءة وحدة الصيانة					
17	Poor communication between the maintenance groups and the users ضعف التواصل بين وحدة الصيانة والمستخدمين					
18	Unavailability of operation and maintenance manuals عدم توفر كتيبات دليل الصيانة والتشغيل					
19	Failure to identify the true causes of defects الفشل في تحديد اسباب الحقيقية للخلل					
	Factors relating to the architectural design **عوامل لها علاقة بالتصميم المعماري**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
20	Shape of the building (e.g. simple or complex) شكل المبنى					
21	Number of stories عدد الطوابق					
22	Glass and Non-glass façade واجهات زجاجية او غير زجاجية					
23	Materials used for interior finishes المواد المستخدة في التشطيبات الداخلية					
24	Materials used for exterior finishes المواد المستخدة في التشطيبات الخارجية					
25	Structure type of the building هيكل المبنى الانشائي					

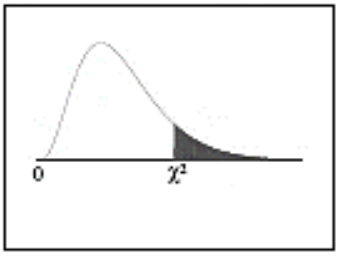
Evaluation of the factors affecting O&M cost (continued)

	Factors relating to the budgetary estimates and economy **عوامل لها علاقة بحسابات الميزانية و الاقتصادية**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
26	Insufficient budget allocated for maintenance activities ميزانية غير كافية مخصصة لاعمال الصيانة					
27	Lack of mechanisms to control the budget allocated for maintenance نقص في الخطط للتحكم في الميزانية المخصصة للصيانة					
28	Failure to forecast the accurate maintenance expenditures الفشل في التنبؤ بشكل دقيق بالنفقات الخاصة بميزانية اللازمة للصيانة					
29	Inflation of maintenance cost التضخم في الانفاق على الصيانة					
30	Taxation الضرائب					
	Factors relating to the costumers or users **عوامل لها علاقة بالمستخدم او الزبون**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
31	Customer Satisfaction راحة الزبون					
32	Occupancy Rate معدل الاشغال					
33	Occupants' or users' attitude سلوك المستخدم					
34	Cultural differences اختلاف الثقافات					
35	Age of the users, (senior, young or children) عمر المستخدم					
	Factors related to the labor **عوامل تتعلق العمال**	**Level of importance**				
		1	**2**	**3**	**4**	**5**
36	Uneducated Labor العمل غير المتعلمين					
37	Availability of skilled labor توافر العمالة الماهرة					
38	Faulty workmanship صنعة الخاطئ					

Evaluation of the factors affecting O&M cost (continued)

	Factors relating to the material being used in maintenance work **عموامل لها علاقة بالمواد المستخدمة في عملية الصيانة**	**Level of Importance**				
		1	**2**	**3**	**4**	**5**
39	Availability of the materials توفر المواد					
40	Quality of the materials جودة المواد المستخدمة					
41	Usage of new materials or ignorance of materials' properties استخدام مواد جديدة أو جهل من خصائص المواد					
	Factors relating to the energy being consumed to keep the hotel running **عوامل لها علاقة بالطاقة المستخدمة لتشغيل الفندق**	**Level of Importance**				
		1	**2**	**3**	**4**	**5**
42	Efficient energy consuming equipment (e.g. energy star products) معدات فعالة في استهلاك الطاقة (تستهلك طاقة اقل بكفاءة اعلى)					
43	Annual energy consumption rate معدل استهلاك الطاقة السنوي					
44	Moving toward sustainability and renewable energy sources التوجة بالنسبة للاستدامة ومصادر الطاقة المتجددة					
	Factors relating to the environment and surrounding **عوامل لها علاقة بالبيئة والمحيط**	**Level of Importance**				
		1	**2**	**3**	**4**	**5**
45	Climatic conditions الظروف المناخية					
46	Greenery of indoor and outdoor environment البيئة الخضراء الداخلية والخارجية					
	Other Factors **أخرى**					
1	. . . . .					
2	. . . . .					

Appendix C: Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

Appendix D: Details of the experts to whom interviews were conducted.

No.	Name of the expert	Position of the expert	Education (Degree)	Years of experience	Name of the Hotel	Location	Star Rating	Visiting date	Contacts
1	Aly Hassan A. Fattah	Engineering Manager	Bachelor's degree	23 Years	Algosaibi	The Corniche	5 Star	07.Mar.16	0138822882
2	Ahmed Ezzat	Director of engineering	Bachelor's degree	18 Years	Sofitel Alkhobar	The Corniche	5 Star	11.Mar.16	0138817000
3	Abdullah Faisal	Operation Manager	Bachelor's degree	12 Years	Milan Furnished Suites	Al-Khobar city	4 Star	12.Mar.16	0138698888
4	G.K. Gajendran	Director of Engineering	Professional degree	22 Years	Crowne Plaza Al	Khobar	5 Star	11.Mar.16	0138988840
5	Upul Perera	Chief Engineer	B.Sc.	17 Years	Coral Hotel	Al-Khobar	5 Star	16.Mar.16	0138696666
6	Fathi Najib	Chief Engineer	Bachelor’s	14 Years	Golden Tulip	Al-Khobar	4 Star	08.Mar.16	0138893222
7	Sen Renganadhan	Engineering Manager	Bachelor’s	25 Years	Le Meridien	Al-Khobar	5 Star	07.Mar.16	0138969000
8	Mohammad Sharif	Maintenance supervisor	Professional	16 Years	Ramada	Al-Khobar	4 Star	07.Mar.16	0138991010
9	Zia	Chief Engineer	Bachelor’s	17 Years	Home Inn	Al-Khobar	4 Star	12.Mar.16	0138500300
10	Mohmmad Hassan	Maintenance Manager	Professional	12 Years	Hala	Al-Khobar	4 Star	08.Mar.16	0138690555

Vitae

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Thesis: Factors Affecting Operation and Maintenance Cost of Hotels in Saudi Arabia.

B.Sc. in Civil Engineering (Oct 2005 – Jun 2010)

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